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BRITISH FOUNDRYMEN'S ASSOCIATION.

THE second annual Convention of the British Foundrymen's Association was inaugurated on Monday forenoon, the 7th inst., in the New Lecture Halls of the Glasgow and West of Scotland Technical College, Andersonian Buildings, George Street, Glasgow. Mr. Robert Buchanan, President, occupied the chair, and there was a large representation of members from both England and Scotland.

Election of Office Bearers.

At a private meeting of members, Mr. Robert Buchanan, Birmingham, was re-elected President, and Mr. Herbert Pilkington, C.E., Vice-President. Mr. F. W. Finch was re-appointed Secretary, and the election of the following members of Council was agreed to:—Messrs. C. Morehead, Rugby; F. C. Shaw, Birmingham; Percy Longmuir, London; J. G. Stewart, Urmston, Lancs; F. J. Cook, Birmingham; J. Ellis, Woolston, Hants; W. Roxburgh, Kilmarnock; Wm. Vickers, Birmingham; T. McFarlane, Horsehay, Salop; R. Mason, Birmingham; W. F. Bagnall, Sheffield; and J. Thomson, Glasgow.

The Secretary's Report.

MR. FINCH, the Honorary Secretary, presented the following report:—

Since our first annual Convention held at Manchester in 1904, I am pleased to tell you that we have made steady progress and increased our membership from 83 to 100 by the end of the year 1904. We have enrolled 21 new members since January, 1905, making a grand total of 121 members, which I think is very satisfactory.

Since the first Convention your Council have made arrangements with the new proprietors of the FOUNDRY TRADE JOURNAL for the journal to be the official organ of the Association, and the proprietors in return have undertaken to supply the journal to our members at the reduced rate of 5s. per annum, and the

Council recommend our members to take in the journal.

A Literary Committee has been formed, with Mr. F. J. Cook as Secretary, to supply matter in connection with the Association to be published monthly, thus keeping our members in touch with the Association.

A vote of the members was taken upon the place to hold this year's Convention, when Glasgow, Birmingham, and London were submitted, the result being 44 for Glasgow, 25 for Birmingham, and 7 for London, giving a majority of 19 for Glasgow over Birmingham.

Since our last Convention our President has lectured at Birmingham and Coventry, and arrangements are being made for him to lecture at Leeds some time in November.

Your Secretary has also read a paper at Bristol before the Bristol and District Employés' Association.

I am sorry that owing to pressure of work in connection with the Association I have not been able to form Manchester and Birmingham into districts as yet, but hope to be able to do so as early as possible after this Convention.

The Council have been called together four times since last August, the meetings having been attended by the majority of its members. A sub-committee was appointed to draw up a code of rules for our guidance. These were submitted at the last Council meeting, and we hope to get a copy of rules into the hands of our members shortly.

The finances of the Association are in a very satisfactory condition, 77 of our first members having paid their second yearly subscription, besides the new members, and I am in hopes that the whole of our old members will retain their membership, thus strengthening our Association.

I have sent a copy of our proceedings to every member of the Association, and also a copy of our first annual report and balance-sheet; this has also been done to every new member when they have joined the Association.

Our President has been a tower of strength to the Council, and we are indebted to him for the arrangements of this meeting. He was ably assisted by Professor Sexton, of this College, to whom our thanks are due, and I also take this opportunity of thanking those members who have kindly come forward to read papers, etc., and enabled the Council to get such a splendid programme together for our second annual Convention.

In conclusion, as Secretary of this Association, I have done the best that has been in my power to further the interests of this Association.

The President's Address.

The PRESIDENT, in the course of his opening address, alluded to the fact that the British Foundrymen's Association were highly honoured in that they were the first to occupy the new and magnificent suite of buildings in which they were that day meeting. Continuing, the President reminded them that the Association had nothing whatever to do with the relationship between employers and employés. It had proved itself worthy of all those interested in the industry. It existed for the consideration of practical and scientific questions pertaining to the industry they represented, and was solely for the benefit and prosperity of those engaged in it. There seemed to be a deep and unreasoning belief, or rather prejudice, continued the speaker, that no improvement or advance or success in method of manufacture could come from anyone not directly engaged in the business. When they added to that the fact that most practical men had a contempt for, or an unbelief in the utility of any written or printed word, one began to have some idea of the stern work which the members of the British Foundrymen's Association had before them. Dealing with technical matters Mr. Buchanan emphasised the importance of having moulders well supplied with a sufficiency of necessary and useful tools. In many big foundries a lack of tools was too often to be deplored, and he regretted to say that many sinners in this connection were limited liability companies, who were presumably wealthy. He maintained that it was the duty of owners to go through the foundries themselves occasionally, in order to see that there was a proper and ample supply of tools.

Technical Education and the Foundry.

PROFESSOR SEXTON, Glasgow, prefaced his paper on "Technical Education and its Application to the Foundry" by a few observations, in which he touched upon the new building in which the Foundrymen's Association had been the first to hold a public meeting. The Institution, of which the new Technical College Buildings, Glasgow, were the outcome, was, he said, founded in 1796. As a matter of fact, he believed it was the first Technical College to be established in the world. It was founded as a result of the will of the late Professor John Anderson, hence the reason why it came to be known as the

Andersonian College. This, he would remind them, was the same John Anderson with whom James Watt came into most intimate contact in his work in the University. Although the College had in the interval undergone many important changes, they had not, he hoped, lost anything of the spirit of John Anderson, nor had they failed to retain a hold of the desire to carry on the work for which the Institution was originally established. Coming more directly to his subject, Professor Sexton said that his views on technical education in general were somewhat heterodox. The confusion which had arisen had largely been due to the fact that each one had looked at it from his own standpoint, oblivious of the fact that what suited one industry would not suit another. All that technical education could do was to give such training as would enable a man to make the best of a practical training in the shop, and to enable him to understand intelligently the work he had to do. It would not even make a bad workman a good one. But it could make a good workman a better one. No amount of knowledge could give the skill on which a workman's usefulness depended. Indeed, he doubted very much whether any technical education would increase a workman's value to his employers while he was working at the same work at which he had already acquired proficiency. The foundry industry was much wider than any one branch, and an intelligent foundryman did not want to continue on the same plane. Foundry work was making rapid advances, yet in many ways it was behind some of the other branches of engineering. He did not, as a matter of fact, know any industry where there were so many trade secrets, which everybody knew—(laughter)—and which were altogether of no real value whatever—(renewed laughter). Secrecy of that description told—was bound to tell—against the development of the industry. If a business was carried on in secrecy, obviously each workman must work out his own methods independently. Professor Sexton thereafter went on to outline a curriculum in technical education which he considered applicable to the foundry.

In the discussion which followed, Professor Sexton, in reply to a request that he should name two books suitable for those desirous of improving their minds on the technical branches of foundry work, stated that most of the text-books were quite good so far as they went. Each of them possessed some deficiency or other. Professor Turner's work, so far as it went, was to be recommended, while Mr. Keep's book, which deals almost solely in experimental work, was also worthy of attention.

The PRESIDENT remarked that Professor Sexton's paper was a most suggestive one indeed. Technical evening classes were of incalculable benefit to foundrymen, and, indeed, he could say that he would never have been President of the Association had he not taken advantage of the evening classes. It was a delight and a pleasure in itself to study the technical side of men's business. If one took such a course of instruction with some mercenary and ulterior object in view one perhaps would be disappointed with the results, but if the studies were pursued out of love for the subject, then the benefit would be considerable.

Cast Iron.

A most instructive paper was read by MR. HERBERT PILKINGTON, C.E., M.I.M.E., Vice-President of the Association.

MR. SMITH said he should like to have an opinion from Mr. Pilkington as to whether or not he thought the same quality of pig-iron was manufactured now as a few years ago. It sometimes occurred to him that they did not now get the same quality of iron as they got some twenty or twenty-five years ago. He believed that to this circumstance was to be traced much of the worry and annoyance which were experienced in foundries to-day. In former days they did not seem to have anything to complain of on this score. His contention was that a foreman moulder was not to be blamed for inferior workmanship if he had not, at the outset, the proper iron to work with.

MR. PILKINGTON said he thought there was probably some ground for the contention of Mr. Smith. At the same time he thought manufacturers were justified in utilising that particular type of iron which they thought best adapted, in point of cheapness and durability, for the particular work that was on hand. It was very much a question of suiting one's own convenience. In Staffordshire, for instance, the hot blast iron had a reputation. No one, however, dreamt of using Staffordshire hot blast unless for special purposes. The cheaper brands in Northamptonshire and Lincolnshire could be employed much more profitably. If a brand of iron suited itself to the price the foundryman was selling for—provided other things were equal, of course—then he (Mr. Pilkington) thought it was a sheer waste of money to use better iron for the purpose.

Professor Sexton said it would be interesting to know if the writer of the paper had made any analysis of the variations in the quality of iron. During the past twenty-five years he (the speaker) had had a good deal to do with iron. In the particular part of Scotland in which the Association was presently meeting, he would remind them that the ores were practically exhausted. With the exception of two works which manufactured, to some extent, nearly the whole of the iron was made from imported material. In such a condition of affairs they could not therefore expect to have the same quality of iron as they originally got from the local ores. Personally, he had no doubt that every effort was made to get the iron as near the same standard as possible, but occasionally they experienced the absurdity of buying material on the assumption that because it had the name and the reputation it was bound to have the quality. Many founders took it for granted, because the iron was manufactured in specific works, that its quality was indisputable. Iron, he maintained, could be got to-day quite as good as hitherto, but the difficulty had arisen because of the greater number of variations. He was not prepared to say how a founder was to find out the quality of the iron. To judge the iron by its percentage of silicon was absurd and unsatisfactory. He had seen iron of all sorts and they each, more or less, contained the same quantity of silicon. Then, again, an analysis was satisfactory only when it was complete and thorough.

Mr. G. W. Fletcher asked if he understood Mr. Pilkington to say that cold blast was inferior to hot blast.

Mr. Pilkington replied that in his opinion the cold blast was distinctly inferior to hot blast, although very largely the same materials were used. Hot blast iron had considerably more silicon, and its percentage of carbon was considerably higher.

Mr. Percy Longmuir said it seemed evident that their old friend silicon was taking a prominent part in this discussion. He had a few jottings of the percentage of silicon which he had found in a series of castings. The results, which might be of interest to the members of the Association, were as follows:—

	Silicon.
Malleable cast	0.4 to 1.0
Chilled castings	0.7 to 1.0
Cylinders, valve bodies, etc	1.3
Machine and engine details, gearing ...	1.5
Soft castings, pulleys, etc.	2.5
Soft thin castings (stove grate)	2.5 to 3.0
Hollow ware	3.0 to 3.5

The President said he had made some experiments in regard to quenching, but the results he secured were very erratic, due probably to the fact that he had utilised the wrong quenching material. He simply tried water and nothing else. The statement that iron and carbon with a mixture of silicon were always white was not absolutely true. The material was white only under certain conditions, and these were rapid cooling. Proceeding, the chairman explained an experiment which had been tried by Mr. Hirons, of the Technical School in Birmingham. This, he said, bore out his contention. In that particular instance the colour was not white, but grey. Rapid cooling, however, was not always possible. For instance, it was not possible in regard to large castings. Then, again, quenching by artificial means was not possible. Continuing, the President said he was a little sceptical as to the qualities of hematite. From his experience he found that foundrymen were getting hematite which had been refused by steel makers. On one occasion he got in hematite which was very high in sulphur; 0.5 ought to have been about the quantity. His firm told the merchant that it was spurious stuff they were giving them. The merchant, however, asked for an analysis, which was conceded. The result was that the hematite was shown to possess 1 per cent. of sulphur, certainly 100 per cent. more than it ought to have done. They very unkindly asked the merchant to take it back, and he (the chairman) did not exactly know who used it. He had no doubt that some firm would find themselves richer in sulphur than they thought they were. That illustrated, at all events, the protection that an analysis could give. They would have kept that sulphury iron if they had not known better. Having given one or two additional instances where spurious material had been attempted to be foisted upon them, the speaker concluded by remarking that foundrymen must make it clear that their foundries were not to be dumping grounds for rejected hematites from steelworks. Glazed pigs were to be looked upon with some little measure of suspicion as very possibly carrying higher percentages of sulphur than one would expect. Where, however, they had high silicon they found low sulphur. At least, that was to be accepted as correct nine cases out of ten. Professor Turner had recently been investigating this question of glazed pig-irons, and his conclusions went to show that it was not impossible to find silicons of from 4½ to 5 per cent.,

carrying at the same time a large percentage of sulphur. Therefore, if they got a high silicon in glazed pig it was not to be assumed that there was no sulphur present, or comparatively none. In fact, the most of it contained a good deal of sulphur. With regard to the point that had been raised as to the strength of iron, he believed they could make iron as strong to-day as ever it had been. They had, however, as Professor Sexton had well remarked, to be guided by this knowledge of the iron.

Mr. Pilkington, in acknowledging a vote of thanks, and in replying to the discussion, said he had to agree with much that the Chairman had said. No doubt there was a great deal of hematite which had a considerable affection for sulphur. There was no doubt also that a great many foundries took it and said nothing. The whole thing, therefore, resolved itself into this, that a foundryman must examine the iron he bought. Much had been said about the different pig-irons in the different districts. He was afraid that the remarks he had made had been taken somewhat too literally.

Excursion to Carron Iron Works.

The Chairman, in announcing that the business part of the proceedings for the day was now over, intimated that an excursion would take place in the afternoon to Carron Iron Works.

Professor Sexton explained that Carron had the distinction of being the oldest iron works in the district. They were started in 1760, and had been the first to use coal. The concern was a most extensive one, and it was one in which everything was carried out on the basis of an analysis.

The outing, which was largely patronised, proved highly instructive and enjoyable.

Tuesday's Proceedings.

Tuesday's meeting was much briefer than those of the preceding day. Mr. Robert Buchanan again presided.

Moulding Sands and Fireclays.

Mr. Percy Longmuir, London, read a paper on "Moulding Sands and Fireclays." In summing up, he observed that he had only touched the fringe of the subject of the definite relationship between the chemical composition of moulding sands and their working properties. He was engaged, he explained, along with Mr. McWilliam, in investigating the matter, and he hoped to be able at a later date to contribute something towards the establishment of a co-relation.

Mr. Mair asked Mr. Longmuir if he had taken any notice of the Clyde sand, which was superior to many sands that were used by founders.

Mr. Pilkington said he had used the Mansfield sand for moulding purposes. It was exactly the same type of sand as that to which the writer had referred. Their experience was that it was altogether rather expensive.

Mr. Ducat said his people had used the Erith sand which was got from the Thames. It was found to be very suitable. Then, again, there was the Belfast sand, which was found to be equal to Mansfield, and much cheaper.

The President said his firm had also had the Erith sand, and proved it to be, as the previous speaker had said, highly serviceable.

All the speakers agreed that the paper was one to which they had listened with considerable interest, and a cordial vote of thanks was passed to the author.

The Microscope and Pig-Iron.

Mr. A. Campion, Carnegie gold medallist, read an attractive and informative paper on the above subject.

The Chairman, having complimented the author on his able contribution, said the members of the Association were particularly fortunate in that Professor Sexton and his assistants at the College had been putting themselves to the trouble of collecting a series of micro-sections of metals for the edification of those present. These micro-sections of metals illustrated better than he could the influence that the microscope exercised. In the laboratory they would find a number of phosphorus specimens which were full of interest.

Mr. Mair said he would like to know if Mr. Campion had made any researches with the microscope in regard to manganese bronze.

Mr. Longmuir thought the time was not far distant—in fact, he believed it would be comparatively soon—when the majority of their foundries would be equipped with microscopes.

Mr. Campion explained in the course of his reply that up to the present he had done nothing whatever in regard to manganese bronze.

A hearty vote of thanks was passed to the author on the call of the President.

Profitable Founding.

Mr. John G. Stewart, Urmston, read a paper on "Profitable Founding."

The President said that if there was

anything weak in the iron founding industry it was the commercial aspect of the business. How many businesses had they known which had gone to the wall simply because the owners did not know what things were costin them? It was an unfortunate thing for themselves, their creditors, and rivals in the trade, that they sometimes took too long to get to the wall. In the interval, of course, they were neither paying themselves, their creditors, or the other owners. Mr. Hadfield, in a paper which he had recently contributed before the Iron and Steel Institute, had referred to the fact that business was jeopardised because of the fact that those who ran the smaller foundries did not know their own costs. As the outcome of that they neither made money for themselves or anyone else. Altogether, he felt that the commercial aspect of the foundry business was one well worthy their closest attention.

A vote of thanks was thereafter passed to Mr. Stewart.

Votes of Thanks.

The PRESIDENT, in formally closing the Convention, said he thought the members would all agree with him in saying that they had had a most excellent series of papers. Their thanks were particularly due to the Governors of the College for permitting them, at considerable inconvenience, to utilise the splendid suite of rooms which had been at their disposal. Then, again, they were under a deep debt of gratitude to Professor Sexton and his confrères in the College for the splendid reception they had accorded the members of the Association.

PROFESSOR SEXTON having briefly replied, the proceedings terminated. In the afternoon visits were paid to the works of the Steel Company of Scotland, at Newton, and to the Glenfield Works, Kilmarnock. In the evening, through the courtesy of the Corporation of Glasgow, a visit was paid to the famous generating station at Pinkston, which is one of the outstanding features of Glasgow's electricity scheme.

On Wednesday a series of pleasure excursions were arranged, to the Kyles of Bute, Loch Eck, and elsewhere.

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THE DARLINGTON WAGON & ENGINEERING WORKS were offered for sale by auction recently, and were withdrawn. It was stated that the Frizington Works had been sold privately.

BRITAIN'S EARLIEST MOULDERS' FLOORS.

BY THOS. MAY, F.S.A. (Scot.).

(*Continued from page* 316).

The first of the perforated clay floors (Fig. 10) was discovered in June, 1904, in one of the fortified annexes outside the south-west angle of the main fortification at Wilderspool. Two others were uncovered close at hand during the same season, one of which is shown in Fig. 11. They were only 17 yards from the iron-smelting furnace No. 1, described at the commencement of these articles, but were separated from it by the foundations of an 8 ft. wall. Another similar floor was come upon subsequently only five yards from the mouth of the same furnace, and was possibly used in connection therewith for casting small pigs or nails, etc.

The floors are layers of hard burnt boulder-clay about 2½ in. thick, and are pierced with round holes 2½ to 4 in. in diameter, at irregular intervals, about 4 in. apart, going right through to the sandy sub-soil. A small upper floor similarly pierced, on the middle of the first, was probably for covering damages in the one beneath (Fig. 10), in which no fewer than 70 holes can be counted.

The holes were all filled with loamy sand blackened with charcoal, and probably served as mould boxes for casting a large number of small objects, such as sling-bullets (*glandes*), simultaneously, though no definite purpose could be assigned to them.

Small, rude melting furnaces of calcined clay or rough stones set round a cavity 9 in. to 1 ft. 6 in. deep and wide, which were found adjoining or upon one side of the first three (see background, Figs 10 and 11), suggested that the material melted in them was lead, for which purpose no great amount of heat was required. An unusual quantity of lead in the form of semi-cylindrical slabs, small strips, thin sheet, and lumps found on their surface or near at hand was not inconsistent with this explanation of their intended purpose.*

A number of iron nails, 2 to 3 in. long, some with a square hollow core running through them, also found in their vicinity, and even in the holes, at first led to the conclusion that they were employed for casting nails, but the metal itself was almost entirely reduced to

*A triangular prism of lead with sharp edges, ¾ in. long, suitable for a sling-bo't, was found during the present season (1905) close at hand.

oxide, and the results of analysis by Mr. Ruddock of a large quantity showed the nails to consist of pure soft iron which could only be melted at a white heat, such as was unobtainable in these rude furnaces. The certificate of analysis states:—

Carbon	0.07	0.07	0.33	0.61
Silicon	None		—	None
Sulphur	0.013			
Phosphorus	0.114			
Mang.	0.024		—	0.083

"All these are wrought-iron nails, and appear to have been made from iron produced direct from the ore. The iron so made was evidently of uncertain composition, as seen by the variation in the amount of carbon."

Moulders' tools, found only in the vicinity of the floors, were "rammers" of hard stone resembling neolithic stone celts in general shape but with their thick end flattened, of which no fewer than twelve were obtained; and as many "sleekers" for smoothing the sand, loam, and clay moulds—pieces of stone, earthenware and cannel, round, square, and oblong in shape, with worn surfaces, one of the sleekers being heart-shaped with rounded sides and sharp edges, like the iron ones used by moulders at the present day.

The dimensions of the floors and adjoining furnaces, commencing from the north, are the following:—

Floor 1.—Length 7 ft. 6 in. from east to west, by 6 ft. 6 in.; oval clay furnace, placed near the middle of the north side, diameters, outside 4 ft. by 2 ft., inside 9 in.

Floor 2.—Eleven feet square; oval clay furnace, at the north-east angle, diameters, outside 2 ft. 6 in. by 2 ft., inside 9 in.

Floor 3.—Length, 6 ft. from east to west by 3 ft. 6 in.; oval clay furnace, on the middle of the north side, diameters, outside 2 ft. 2 in. by 1 ft. 4 in., inside 10 in. Two stone circles, enclosing circular cavities 9 in. across, were on the west side.

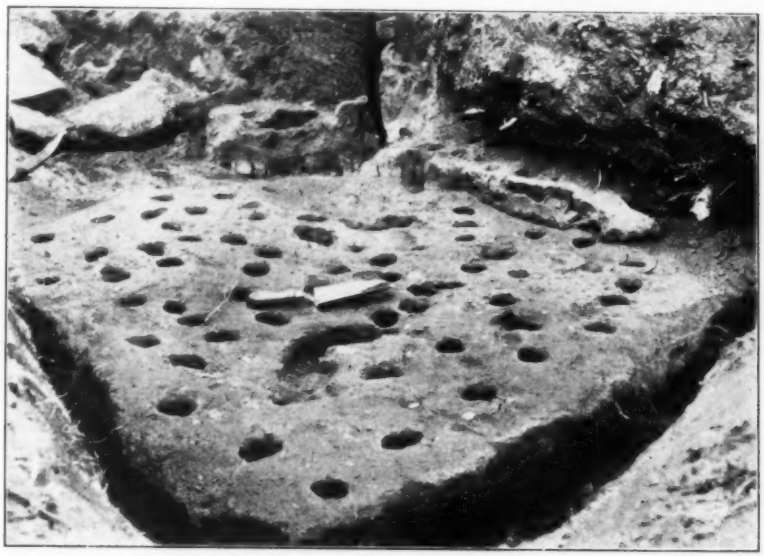

FIG. 16.—PERFORATED CLAY FLOOR AND MELTING FURNACE NO. 1, FOUND AT WILDERSPOOL, 1904.

Floor 4.—Seven feet square. (The north-east angle was inaccessible owing to the intervention of trees, and no furnace was discovered near at hand.)

Base of Clay Crucible Furnace.—Fig. 12 shows the base of a large furnace pierced round the inside with seven similar holes, which was uncovered on the north side of the field, just outside the north-west angle of the fortification, and remained a

puzzle until one of the crucibles, slightly vitrified and showing traces of bronze both inside and outside, was subsequently discovered whole in another part of the ground, near to a small furnace formed of three stones set on edge and inclining inwards, along with a quantity of black ash and unspent charcoal, and other traces of bronze working. The crucible, though of good material, is only a quarter of an inch thick and about the size of an ordinary duck egg, and being sharply conical it was perceived that the holes in the hard floor of the furnace were covering the remains of workshops (Fig. 13) on the north side of the fortified enclosure along the river bank and eastern extension of the main Via at Wilderspool, which proved of great interest and very prolific of finds. On the inside edge of the Via were the solid stone foundations of the front wall of a building, and in the rear was a hard clay floor measuring 23 ft. in length, 9 ft. in width, and 3 in. thick.

On its surface, with the fire-hole and fantail hearth at the middle of its south side, was a long reverberatory furnace

FIG. 11.—PERFORATED CLAY FLOOR AND MELTING FURNACE NO. 2, FOUND AT WILDERSPOOL, 1904.

intended to receive the pointed ends of crucibles. An opening in the rear of the furnace was also provided for giving access to the interior without removal of the fire. The following are the dimensions of the furnace:—

Clay platform, length, from north to south, 4 ft. 3 in.; breadth, 3 ft. 3 in.; inside cavity, 2 ft. 9 in. by 1 ft. 9 in.; hearth, 2 ft. 9 in. square.

Bronze Founder's and Enameller's Workshop:

The season of 1901 was devoted to un-

(7 ft. 6 in. by 1 ft. to 1 ft. 8 in. and 4 to 6 in. deep), enclosed in the usual massive clay platform (8 ft. 6 in. by 4 ft.), having an opening in the rear, 6 to 10 in. wide, to give access to the contents without raking out the fire. From the back of the stoke-hole a slight batter given to the base of the furnace towards both the openings formed a sort of fire-bridge, in order to throw down the heat on the surface of the metal in the crucibles or other material. The stone jambs of the fireplace were in position, but the over-arched cover had collapsed, and billets of burnt wood re-

mained in the neck of the fire-hole between two layers of terra-cotta.

On the east side of the floor, and probably forming part of the same premises, were (1) an oblong pavement (13 ft. 6 in. from north to south by 11 ft. 6 in.) of large cobble stones closely set, and not one missing, on a 6 in. layer of stiff clay; (2) a furnace enclosed in an oblong clay platform (8 ft. 6 in. by 5 ft.) along the north side of the pavement—the cavity in the form of a deep footprint, the heel portion, or well, 1 ft. 6 in. deep and wide, with a projecting boss on the bottom 4 in. high for supporting the crucibles (which were probably set round the inside and embedded in ash or charcoal); the fire-seat towards the toe widening to about double, and sloping up to the top of the platform. As it was originally over-arched, the flame was by this means driven downwards and concentrated on to the surface of the metal in the crucibles, and air excluded. (3) A peculiar feature was a leat or water-course traced between the two floors in nearly a direct line for 160 ft. north and south, with only a slight bend at 51 ft. from the Via. Its width at the Roman level was 3 to 4 ft., and its depth below the existing surface 5 ft. 6 in., or about half that depth originally. To prevent the soft sandbank from being trampled into the ditch a pitching of sandstone rubble 7 ft. wide was laid for 50 ft. from the Via along the east side, and 5 ft. wide for 39 ft. along the opposite side; and to give convenient access to the water channel there was a more solid pitching of large stones puddled with clay along the batters over against the cobble pavement, which was probably that of a central courtyard. An ash-blackened layer of soil surrounded the whole, but was wider and deeper on the south side, whither the refuse appeared to have been swept or carried, to the rear of the workshop. The objects derived from the layer and from the clay lining and black muddy deposit along the bottom of the leat are too numerous to describe, but the following summary will sufficiently indicate the character of the industry which was being carried on:—

FIG. 12.—CRUCIBLE FURNACE FOUND AT WILDERSPOOL, 1904.

Coins.—Denarii of Trajan, Hadrian, and Ælius, a first bronze of Trajan, a second bronze of Nerva, and three others too much corroded for recognition.

Several of the most interesting among the bronze objects are illustrated in Fig. 14, viz.:—

Bronze.—Harp-shaped fibula, length

2½ in., with collar-moulding on middle of bow, coiled spring and part of pin (No. 2);

Fibula, length 1¾ in., with lozenge-shaped body decorated with central disc dog-tooth ornament, and stud with wheel-cross on summit (No. 4);

Penannular ring brooch, diameter 1⅛ in. (broken), with one moulded end and loop hinge of pin (No. 11);

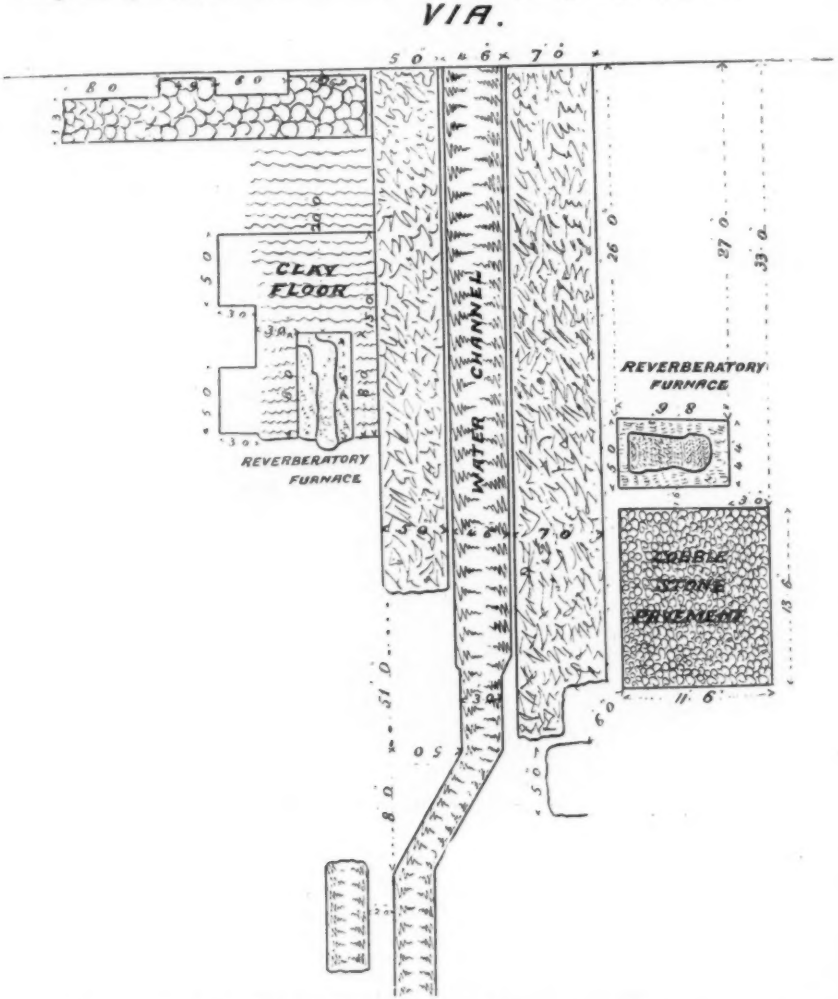

FIG. 13.—PLAN OF BRONZE FOUNDER'S AND ENAMELLER'S WORKSHOPS FOUND AT WILDERSPOOL, 1901

of glossy black and band of pale greenish corroded enamel, slender cross-bar with part of pin, and head of animal with two eyes, one of which retains a small red gem forming an eyeball (No. 6);

Bow-shaped fibula, length 1½ in., with

Fermail or button, diameter ¾ in., decorated central disc of faded yellow enamel, and encircling band of cable pattern, opaque white and pale green alternating (partly corroded) (No. 10);

Stud (two thin discs, diameters ⅜ and

9-16 in., united by a short bar, diameter 1-5 in.), the lower plate plain, the upper one decorated on the surface with enamel of most delicate workmanship—a square of bright red, with arms of an expanding Celtic cross on each side in minute chequers (eight squares to $\frac{1}{4}$ in.), white and bright green alternating, and the triangles between the arms of the cross filled with pure white. Unfortunately, the retaining band of bronze round the edge is partly corroded (No. 9);

Strip (chasing chisel?), dimensions $2\frac{3}{4}$ by $\frac{1}{4}$ by 1-10 in.;

Portion of rim of patera, with edge slightly thickened, and two incuse lines by way of ornament on the outside;

Small billet, length 1 in., nipped by pincers at both ends;

Odd bits of plate, wire, and drops of the same metal;

Spring handle of a small pair of enameller's pincers (No. 14).

The following bronze objects on

FIG. 14.—BRONZE OBJECTS FOUND AT WILDERSPOOL IN 1901.

Head of pin in form of a round boss, and encircling rim (cast hollow) (No. 7);

Altar-shaped handle or staple, length $2\frac{3}{8}$ in., with half-round mouldings at plinth and cornice, square shaft, and cylindrical loop, diameter 7-10 in., with ornamental stud on summit, a shank or tang at opposite end broken;

Two plain rings of equal size (1 in. outside, $\frac{3}{4}$ in. inside diameter), one smoothed and polished, the other retaining the fin, or rough seam from the cracks of the mould on both sides, showing it was cast on the same spot and left unfinished (Nos. 13 and 15);

Fig. 14 were found in other parts of the site, viz.:—

Boat-shaped object of uncertain use (No. 1);

Oval brooch in enamel (pin wanting) (No. 3);

Head of pin in the form of a vine leaf (No. 5);

Handle of iron knife or butcher's steel in the shape of the fore-part of a dog issuing from a calyx (No. 8);

Penannular ring brooch with moulded ends and portion of pin (No. 12);

Large-eyed needle (No. 16);

Bow-shaped fibula and part of pin (No. 17);

The glass specimens include lumps of crude enamel or frit in turquoise blue, cobalt blue, pale greenish, and black glossy material, which are of special interest as indications of the kind of industry carried on in the adjoining workshops.

A large quantity of fragments of black, grey, and red pottery of Romano-British type and *terra sigillata*, *Samian*, was found in the bottom of the leat.

The purpose for which the east-most furnace, adjoining the cobble pavement, was employed is shown by the discovery underneath the surrounding platform and in the black lining of the adjoining water-channel of five fragments of crucibles coated on the inside with corroded bronze and some other greyish metal (tin or zinc). One fragment was $\frac{3}{8}$ in. thick, and large enough to indicate that the crucible was originally cup-shaped, about $2\frac{3}{4}$ in. across the rim and $1\frac{3}{4}$ in. deep. The metal adhering to another of the fragments was analysed by Mr. Ruddock, whose certificate states the following particulars:—

Copper oxide	... 43.65 =	Metallic copper	...	34.85
Tin oxide	... 4.89 =	„ tin	...	3.82
Zinc oxide	... 0.75 =	„ zinc	...	0.60
Insoluble residue	41.31			
Iron oxide, alkalis, etc.	... 9.40			
Total ...	...100.60			

"These proportions would give a bronze of the composition:—Copper 88.74, tin 9.73, and zinc 1.53 per cent."

It is, therefore, a specimen of the brass (orichalcum), of which the sesterii, or first bronze coins of the Higher Empire, and probably also the fibulæ and other such articles found near at hand, were composed, which was reckoned at double the value of the ordinary red bronze containing about 90 per cent. of copper and 10 of tin, with no zinc. The metal zinc was unknown to the Romans, but was added in the form of carbonate (calamine), which is named cadmia by Pliny, Nat. Hist., xxxiv., 10, "lapis ex quo fit æs cadmia vocatur."

A lump of vesicular scum or sandiver from the same spot, analysed by Mr. Ruddock, was found to contain:—

Alumina	4.22
Lime and magnesia	0.35
Insoluble residue (silicate of alumina) with a little lime and magnesia and 4.43 of alkalis	95.02
	99.59

and was deemed by him on account of its purity to be waste from enamel or glass-making.

FOUNDRY COST SYSTEMS.*

By Ellsworth M. Taylor.

The properly regulated modern cost system is the relentless eye constantly examining and scrutinising every nook and corner of your business, calling your attention automatically to leakages and excessive expenditures, substantiating or disproving whatever information may have come to you verbally or by observation, enabling you immediately to use all your energy and brains to cure the sore.

"Why is it," asks the manufacturer, "that we only show a profit this year of 12 per cent., as against 20 per cent. one year ago? We have been operating under practically the same conditions and have figured our selling prices in the same way."

There is evidently a serious error in your costs. Your direct labour on certain jobs has greatly exceeded your estimate. The amount of your burden or unseen dollars has exceeded your expectations. Your orders have actually happened to run to that class of goods which you are regularly selling at a loss because you have no accurate method showing what your actual burden or unseen dollars amount to, and your method of applying an inaccurate burden to your first cost to establish your selling price is radically wrong. Your crude method of using your pay roll and material expenditures gives you no proper line on your leakages, which you should measure in dollars and cents at least once a month, instead of allowing it to go undiscovered until the end of a fiscal year, when it is too late.

To illustrate how easy it is for the foundryman to deceive himself in regard to his costs, one example will suffice:—

An Example of Inaccurate Costs.

Of how much value is accurate cost of information to the foundryman? It may mean the very life of his business. Accurate cost methods are of equal value to the small and large foundry, and the general scheme of foundry costs is the same whether you are operating a jobbing foundry or a foundry in connection with a machine shop. As a matter of fact, the machine shop foundry must be considered in the light of a jobbing foundry—that is, the treasurer of the company agrees to buy the entire output of the foundry for a certain period at certain fixed prices, and the foundry must produce good castings at a cost sufficiently

* From a paper read before the American Foundrymen's Association, New York, June, 1905.

less than the market offers to warrant the treasurer in setting the foundry up in business.

If the foundry cannot do this it would be to the advantage of the business to close the foundry and buy the castings outside. And the treasurer cannot afford to deceive himself as to the actual conditions. He will have installed a monthly cost report, divided into three general sections: metals melted, producing labour, expense. The monthly postings to these sections will be made up as follows:—

Materials Account.

In every foundry there are certain materials which are purchased from hand to mouth—that is, in quantities which are practically used up from month to month. Materials of this kind are usually miscellaneous supplies, such as molasses, facing, flour, small hardware. From the cost and accounting standpoint it is best for every foundry to draw up a list of all materials of this nature, and as soon as the invoices covering these materials are received and checked, the face value of the invoices should be immediately discharged off into the proper sub-division of the expense section of the foundry cost operations for that period.

At the end of each month the accumulated totals of these items will be posted to the monthly cost sheet.

Invoices covering heavy materials, such as the different kinds of metals, coal, coke, sand, lumber, should be charged into a general foundry stores account, and a stock ledger account in card form should be kept of each different kind. These ledger cards will be debited in the first place with an inventory of the quantity on hand, and thereafter with the quantities as they are received.

A daily melt record must be kept showing in detail and by actual weight the quantities of the different kinds of materials which have passed over the cupola flood. This daily record must pass promptly to the cost department, and the quantities shown must be posted to their credit side of the ledger card covering that particular material.

In the case of all heavy metals which do not pass over the cupola floor methods must be provided for daily records of quantities used. Take sand, for example. Pads should be nailed up in a convenient place in the path of the employé whose business it is to transport the sand from the sand bins into the foundry proper. Each time a load of sand is carried in a mark must be made on the pad. The capacity of the wheelbarrow or other conveyance is known, and the quantities used may thus be easily obtained. These records must also be transmitted to the cost department and corresponding entries made on the ledger cards.

The ledger accounts must be closed each month, and the quantities of metals used will constitute the gross melt for the month under the "Metals melted" section of the cost sheet. The quantities used of all other heavy materials will be carried into the proper sub-division of the "Expense" section of the cost sheet. These card ledger accounts must be periodically checked up with the actual quantities on hand, and thus constitute one check on the accuracy of the daily reports. In brass foundries particularly the importance of this close check on materials cannot be overestimated.

Productive and Non-Productive Labour.

The pay roll must be divided into two general classes, productive and non-productive. From a cost-keeping standpiont productive labour includes only such labour as is capable of being charged direct to a certain casting or job.

The importance of distinguishing productive labour must be emphasised, because in analysing your costs the productive hour or the productive dollar is the acknowledged unit of distribution for all foundry expense or burden dollars. Labour of this kind will be made up principally from the money paid to moulders, but in some cases will include helpers and core makers.

Non-productive labour is all labour, including clerical work, which for any reason whatever is incapable of being charged to a particular casting or job. In every foundry there are a certain number of general utility men who are really direct producers, but who spend only two or three minutes consecutively on any particular casting or job.

From a clerical and practical standpoint it is not often feasible to attempt to charge two or three minutes to a certain casting, and for this reason all such work must be classed as non-productive, and included in the proper sub-division of the expense section of the cost sheet.

In addition to the material and labour distribution to the expense section there must be charged in each month a fixed sum which is one-twelfth of the total amount of private pay roll, insurance, taxes, interest, depreciation, and all other items incapable of direct distribution.

The cost sheet is then ready for certain final postings, which must come from the monthly production sheet described below.

A Daily Record of Production must be kept which will give—

1. The gross quantity of saleable castings produced.
2. The gross quantity of foundry tools and temporary equipment produced.
3. The gross quantity of bad castings returned from machine shop or customers.
4. The gross quantity of bad castings detected in foundry.
5. The gross quantity of gates, sprues, runners, etc., made.

The accumulated totals of these items posted to the proper divisions of the monthly production sheet give the gross pounds which can be accounted for out of the metals melted and the pounds lost in melting. The totals of items 2, 3, 4 and 5 must then be credited to the cost sheet record of gross melt, and in this way an amount is developed showing the net number of pounds actually used to produce the net quantity of saleable castings. Reducing these weights to dollars and cents and combining with labour and expense data on cost sheet gives you the cost of your product and your loss or gain.

If the production sheet is properly designed it will establish beyond doubt the reason for any fluctuation in cost one month as against another. This method of working the cost down from gross metals melted to net quantities and values is an absolute check against serious error, whether clerical or physical. For instance, suppose the figures show a greater quantity of saleable castings produced than pounds of net material used, or suppose a loss in melt is developed of more than 7 per cent. In the first case, if the error is merely physical your costs are seriously affected. Or if you are operating on a piecework basis you may have paid for more castings than have actually been produced.

In the second case the error may be physical, or there may be serious trouble with your cupola. In either case the subject requires careful consideration and investigation. A close scrutiny of all the facts set forth on these monthly reports will likewise give the foundryman a line on the actual efficiency and condition of the entire foundry.

Analysing Costs.

In the large iron foundry comprising green sand, dry sand, loam and machine departments it is necessary that the daily reports and records provide for a distribution of labour, castings produced and castings lost by departments. In the jobbing foundry it is important to know the relative value of each customer's business. To establish these facts it is necessary to accumulate the total number of productive hours or the total productive labour value expended on all work for the customer during a given period.

The cost of the net material used per pound is shown by the monthly cost sheet, as is also the hourly or percentage rate of expense. These units may be readily converted into total dollar expenditures, giving the entire cost of the product up to your shipping office door. To know the cost of particular castings or any class of castings the foundryman must have a record of the actual productive labour, in hours or money, expended on the castings. With this fact established the total cost is figured in the same manner as outlined in the previous paragraph.

In brass foundry work the cost of the net material used will vary according to the value of the different mixtures; otherwise the general method of figuring is the same as outlined above.

Foundry Orders.

The foundry order system should be so designed that the initial entry will by one writing (1) constitute the permanent office record; (2) advise the pattern shop to prepare the patterns and deliver them to a certain moulder; (3) advise the core shop of the number of cores required and to whom to deliver them; (4) authorise the moulder to proceed with the work, tell him when delivery is required, and provide him with a place to record the number of good and bad castings which he produces; (5) give complete shipping instructions to the shipper; (6) act as a tracer notifying the office of (*a*) the date of delivery of pattern to foundry; (*b*) moulder to whom work has been assigned; (*c*) date of final delivery of cores; (*d*) date of completion of order by moulder; (*e*) final date of shipment.

The foundry manager is in this way at all times in touch with every order which has been issued, and can answer inquiries with the least possible delay. A system of this kind is so elastic that it permits each foundry manager to arrange it to cover conditions which may be peculiar to his foundry alone. Furthermore, the order system is closely allied to the method of analysing costs, and warrants careful thought and attention.

Patterns.

Every foundry manager realises the importance of a quick handling of patterns. To facilitate this work all patterns received by the foundry should be cata-

logued, preferably in card form. The catalogue should give a complete description of the patterns and the core boxes, stating the number of pieces in each.

The pattern storage loft should be divided into sections, bins and shelves, and numbered or lettered. On the receipt of a pattern it should be assigned to a permanent resting place in the storage loft, and letters or numbers indicating the location should be marked on each part of the pattern. At the same time the location is entered on the catalogue card.

In many foundries to-day there is an annual leakage of a great many dollars because of the crude and unsystematic manner of handling patterns. Lack of system here places the foundry at the mercy of one or two men who may happen to remember that such and such a pattern was originally stored in a certain section. Shipments are many times delayed and errors are invited, with a consequent feeling of annoyance and irritation reaching from the manager to the shipper.

Again, what will be the loss to the foundry, measured in dollars and cents, if the foundry should be deprived of the services of the man who carries the information in his head? With the patterns properly marked and catalogued the pattern storage loft becomes an automatic machine which may be operated by any employé who can read numbers and letters.

Inspection.

Valuable information will be obtained from the proper record of bad castings. It is always to the advantage of the manager to have a positive record of the relative value of his workmen. This information comes primarily from the inspector or from the employé acting in that capacity.

For this purpose "Castings rejected" slips are issued by the inspector for each casting lost. These slips authorize the workman to reproduce the castings when necessary, act as a notification to the office to deduct the amount from the workman's pay if the work is piecework, and, finally, are so treated in the office that a true record of the value of the workman is obtained. In times of business depression or internal trouble and discontent these individual records may be effectively used by the management.

Chemical Analysis.

The importance of a periodical chemical analysis of the metals melted and the product obtained is now so thoroughly recognised that it is hardly necessary to discuss the subject. The chemist not only keeps the foundryman from getting into trouble in his mixtures, but may reduce the costs by recommending that a greater percentage of scrap may be put into the mixture because the metal people occasionally ship materials running higher in certain chemical properties than called for in your order.

The cost department should prepare a set of statistics so arranged that the most important points of the cost and production sheets may be compared from month to month in deadly parallel columns. These statistics should cover the entire fiscal year on one form, and in addition to data of cost, etc., should record ratio of coal and coke to metals melted, average number of producers and non-producers, average number of days worked, and all other data of importance to the management.

—o—

Messrs. Cochrane & Company have succeeded in obtaining a large order for cast-iron pipes for the Barking Gas Company.

Considerable interest is being centred in the affairs of an old-established firm of metal rollers, Samuel Walker & Company, Fazeley Street, Birmingham. On the application of debenture holders, Mr. A. H. Gibson (Messrs. Gibson & Ashford) has been appointed manager and receiver. It is intended to carry on the business in the interest of the debenture holders.

The Gelsenkirchener Gussstahl-und Eisenwerke vormals Munscheid & Company, of Gelsenkirchen, Westphalia, have appointed Messrs. Hughes Chemery & Company, 54, Billiter Buildings, Billiter Street, London, E.C., as their sole represntatives for London and the South of England. The Gelsenkirchener Company are manufacturers of every description of steel castings up to 50 tons weight.

A company is been formed with a view to the working of a new iron process, the invention of a German engineer, the object of which is the conversion of scrap wrought iron into malleable cast iron or steel. Castings made by this process are said to possess all the qualities of the highest class malleable iron, and by one melting alone it is claimed that the finest tool steel is produced! Metal made by the process has been tested at Owens College, Manchester, and at the works of Messrs. Kirkcaldy & Son, London, S.E.

RUEBEL METAL.

Ruebel metal is a new alloy which possesses great strength, is anti-corrosive, and casts, forges, and machines well. It also presses stamps, and drop-forges well. Owing to its homogeneity and density it is very suitable for certain classes of bearings where so-called anti-friction metals will not stand. It does not deteriorate in strength to the same extent as gun metals or copper at comparatively high temperatures, while its price is found to compare favourably with that of alloys of inferior properties.

The ingredients may be varied somewhat to meet special requirements; thus for a metal having great elongation the ingredients are slightly different to a stronger and harder metal having less elongation. The ingredients of the casting metals also differ somewhat from those of the forging metals, although both forge well. Generally speaking, the metals are made in two classes; those for casting, and those for forging. The purposes for which they may be used are so numerous that it is difficult to do more than indicate general applications. Among other things the casting metal may be suitably used for pump bodies and discs, ships' propellers, motor-car details, numerous ship details, steam fittings, bearings, gun carriages, toothed wheels, hydraulic work, details of overhead work for tramways, details of sugar machinery, details of condensing plant, etc.

The malleable metal may be used for pumps and piston rods, bolts, studs, nuts, tubes, sheets, bars, angles, tees, and other rolled sections; also for tail rods, pump spindles, condenser plates, boiler and firebox stays, hull plates, and angles for boats, forged propeller blades, etc. The metals are supplied in ingots, castings, forgings, or rolled sections.

Casting Ruebel Metal.

Dry moulds painted with china clay give the best castings. The moulds and cores should be well ventilated. The runners and risers should be of such proportions and their junction with the casting should be of such area that they are the last parts of the casting to set. In other words, the runners and risers should remain fluid as long as possible, in order to keep the casting well fed during contraction. It is useless to provide large runners and risers if the passages connecting them to the casting are restricted in area, because the metal sets in the passages and prevents the fluid metal from feeding the body of the casting. Risers should be provided on any thick parts, but, of course, the usual precautions should be observed by designers to distribute the metal as evenly as possible in the casting. Ruebel metal is nearly twice as strong as gun metal, and castings in Ruebel metal can be made correspondingly thinner and lighter than in gun metal.

Ruebel metal contains zinc. It should, therefore, be melted as quickly as pos-

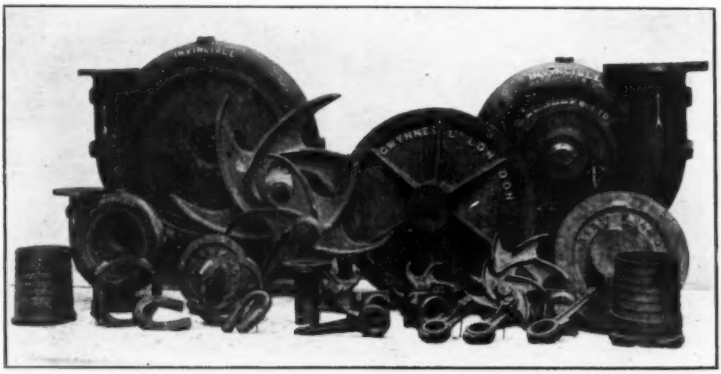

FIG. 1.—GROUP OF CASTINGS OF RUEBEL METAL.
(Two Test Pieces bent cold are shown on the Left.)

sible, and the crucible should be taken out of the furnace or the furnace tapped before the zinc commences to burn. The loss in melting should not exceed 2 per cent., and this loss should be made up by a corresponding addition of zinc at each re-melt. The zinc should

when cast in chills. The contraction in cooling is about 3/16ths inch in one foot.

Forging Ruebel Metal.

This metal forges well at a dull red heat, and the forging may be finished almost at a "black" heat. It forges

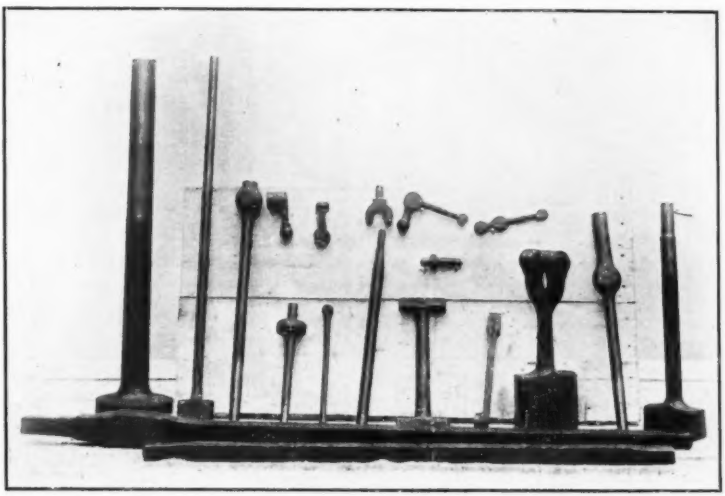

FIG. 2.--GROUP OF FORGINGS OF RUEBEL METAL.

be added in small pieces just before the metal is ready to pour. Crucibles with covers are best. Before pouring, impurities should be carefully skimmed off; and after adding a little sal-ammoniac, the metal should be stirred well with

best by frequent blows of a light hammer given in such a way that the density is increased regularly and evenly all over the forging. Any sudden diminution of section, unless the metals are first hammered to a consistent density,

FIG. 3.—CYLINDER CASTING IN RUEBEL METAL.

a mild steel rod. For small repetition work these metals give the best results when cast in chills, but as soon as the casting has set it should be turned out of the chill into cold water. The chill should be similarly cooled between each cast. Ingots for forging are also best

should be avoided. The best results are obtained when the cast ingot is reduced to about 115th of its original area by hammering. The metal so obtained can be worked in a similar way to steel. Where a fine skin is required, it is better to roughly machine the surface of the cast

ingot before forging. The anvil and forging tools should be frequently swept to prevent scale from being hammered into the surface of the forging.

The following test figures give some idea of the strength of Ruebel metal:—

Tests made by Messrs. David Kirkaldy & Son.

Metal.	Tensile strength. Tons per sq. inch.	Extension in 5 in.	Date of test.
Metal H. Rolled strip	38.4	13.8	Dec. 16, 1904.
	38.8	15.6	
	39.9	12.2	
	38.3	13.4	

Tests made by Mr. R. H. Harry Stanger.

Metal H. Forged	26.5	26.5	Jan. 30, 1905.
	31.81	38.6	
	35.11	35.7	

Tests made by Messrs. David Kirkaldy & Son.

Metal B. Cast ...	31.8	10.2	Feb. 1, 1905.
Metal H. Cast ...	30.1	8.2	
	29.7	21.6	
	27.3	14.4	
Metal B. Cast ...	30.5	7.8	Feb. 6, 1905.
Metal H. Cast ...	29.9	7.5	
	32.7	20.2	
	30.9	13.6	

Ruebel metal is now being largely used by Messrs. Gwynnes' Limited, of Hammersmith, the well-known centrifugal pump makers. Messrs. Gwynnes' find that centrifugal pumps made of this material do not corrode with acid water and give results equal to bronze castings. They have as a result become largely interested in the manufacture of the metal.

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THE statement of affairs in connection with the failure of the Sir Hiram Maxim Electrical and Engineering Company shows liabilities £55,481, of which £19,192 are unsecured, and an estimated surplus in assets of £8,449. Mr. A. F. Whinney has been appointed liquidator, with the assistance of a committee of inspection.

A WORKING arrangement has been arrived at between Ferranti, Limited, and Witting, Eborall & Company, Limited. In future Messrs. Ferranti's interests in India, South Africa, and on the Continent will be attended to exclusively by Messrs. Witting, Eborall & Company. The Witting firm will represent Messrs. Ferranti in Great Britain.

PIG-IRON GRADING BY ANALYSIS.*

BY HAMBDEN BUEL.

A YEAR or more ago the writer received from the American Foundrymen's Association a reprint from its "Journal" on "Methods of Determining the Constituents of Cast Iron." It was the result of long and very careful deliberation to arrive at a system of uniform methods for pig-iron analysis. Needless to say the object was one deserving of the highest consideration and the support of all interested. However, I must say that I was at the time very forcibly impressed with one point—Would the adoption of such standard methods of pig-iron analysis eradicate the differences met with among pig-iron makers and consumers? While I do not criticise the adoption of standard methods of pig-iron analysis, I believe the case should be thoroughly diagnosed before treating and then the proper remedy applied. The error into which so many fall is in believing that some road is better than no road. I believe that no road would be better, as then one would be inclined to be more careful. With the foregoing points in mind, the writer a few months ago undertook some investigations relative to differences in pig-iron analysis. Our company decided about the first of the year to abolish fracture grading and grade all iron by analysis, virtually accepting the basis of grading as recommended by the American Society for Testing Materials.

Method of Handling Iron.

The handling of iron at our plant is somewhat different from the practice at most furnaces. In the first place, our iron yard is practically a continuation of the cast house and is traversed by a travelling crane with a span of about 60 ft. The columns supporting the runway of this crane are 25 ft. from centre to centre. As soon as a cast has cooled somewhat the beds are carried out bodily and placed upon the iron yard, each cast being placed separately and marked with the cast number and date. The next day the cast is laid out upon the ground and broken by means of sledge-hammers. The pigs are picked up by hand into steel boxes holding about 2 tons and dumped by means of a crane into blocks, according to analysis. These blocks are located between the columns of the runway, and hold when complete 300 to 350 tons of

* Abstract of a paper read at the Atlantic City meeting of the American Society for Testing Materials, June, 1905. Mr. Buel is chemist of the Central Iron & Coal Company.

iron. When a block is completed it is opened for shipment and the analysis computed from the analyses of the several casts entering into it.

The procedure in the investigation consisted of three steps: First, sampling each cast by the shot method, taking nine dips uniformly throughout the cast; second, taking a sample of six pigs from the same cast; and, third, sampling each car loaded from the respective mixtures. The nature of the investigation was such as to necessitate its extending over a considerable period, as a few isolated instances would be practically worthless. A complete record was kept of the cast analyses, both shot and pig samples, from January 25, when the furnace was blown in, to May 15, when it became necessary to suspend the investigations on account of the burning of our machine shop, where our pig samples were drilled.

Table A is a record of the mixtures of iron, showing the average upon both the shot and pig sample basis, together with the average of the cars loaded out of the respective mixtures, and embraces a total of over 16,000 tons of iron of all grades.

Variations in Silicon and Sulphur.

A tabulation of 368 casts, giving both the shot and pig sample analyses, showed that in 45.92 per cent. of the cases there was a variation of less than 5 per cent. in the silicon content of the shot and the pig samples of the respective casts; in 23.91 per cent. of the casts a variation of from 5 to 10 per cent.; in 21.19 per cent. of the casts a variation of from 10 to 20 per cent., and in 8.97 per cent. of the casts a variation of over 20 per cent. Out of this total 31.25 per cent. showed that the silicon content of the pig sample was higher than in the shot samples.

The results of the sulphur contents were not nearly so gratifying, the shot sample yielding invariably lower sulphur than the pig samples. In 39.67 per cent. of the cases the difference was 0.01 or less, in 27.99 per cent. the difference was between 0.01 and 0.02, and in 32.33 per cent. the difference was above 0.02. The writer has attempted to compare the result of this exhibit with the burdening, blowing, blast pressure, atmospheric humidity, variations in blast and gas temperatures, presence of water, and irregular furnace working, but in the absence of any very definite conclusions will not essay to present the comparisons in this paper.

Table A herewith is most interesting and comprehensive. I would call attention to the three different sets of average analyses, especially in respect to the silicon content. Out of 432 cars shipped and embodied in this exhibit a little less than 13 per cent. showed a variation of between 10 and 20 per cent. above or below the computed silicon content of the respective mixtures, while about 2½ per cent. showed a variation above 20 per cent. In every instance the discrepancy was traceable to mixtures containing casts which showed the wider variation in silicon content of the shot and pig samples. The method then in vogue of mixing was not sufficient to overcome this effect. To explain this: The outer wall of the block was from 8 to 10 ft. be-

Table A.—Analyses of Shot, Pig and Car Lot Samples.

Grade by silicon.	Lot No.	Average shot analysis. Silicon.	Sulphur.	Average pig analysis. Silicon.	Sulphur.	Average car analysis. Silicon.	Sulphur.
1.25	1	1.19	0.079	1.15	0.117	1.31	0.122
1.25	2	1.04	0.063	1.05	0.082	1.21	0.080
1.25	3	1.19	0.063	1.20	0.093	1.20	0.073
1.25	4	1.33	0.039	1.30	0.038	1.83	0.056
1.25	5	1.26	0 040	1.28	0.083	1.51	0.050
1.75	1	1.91	0.072	1.88	0.091	2.01	0.111
1.75	2	1.87	0.061	1.89	0.087	2.07	0.080
1.75	3	1.76	0.040	1.57	0.057	1.94	0.056
1.75	4	1.76	0.043	1.79	0.052	1.77	0.060
1.75	5	1.71	0 025	1.75	0.033	...	....
1.75	6	1.89	0.024	1.68	0.027	1.91	0.040
1.75	7	1.38	0.038	1.52	0.045	1.80	0.065
1.75	8	1.85	0.018	1.82	0.026	1.81	0.040
1.75	9	1.85	0.025	1.84	0.031	1.91	0.055
1.75	10	1.97	0.041	1.90	0.050	...	....
1.75	11	1.81	0.029	1.80	0.034	1.63	0.044
1.75	13	1.93	0.036	1.97	0.034	1.83	0.049
1.75	14	1.72	0.024	1.72	0.025	...	....
1.75	16	2.08	0.062	2.01	0.074	...	....
2.25	1	2.33	0.048	2.34	0.053	2.33	0.054
2.25	2	2.18	0.120	2.20	0.132	...	....
2.25	3	2.18	0.044	2.15	0.058	2.19	0.060
2.25	4	2.21	0.039	2.05	0.051	2.32	0.046
2.25	5	2.22	0.047	2.43	0.059	2.28	0.081
2.25	6	2.27	0.027	2.23	0.028	2.38	0.032
2.25	7	2.26	0.017	2.15	0.022	2.51	0.022
2.25	8	2.21	0.028	2.15	0.036	2.43	0.069
2.25	9	2.26	0.034	2.25	0.034	2.34	0.037
2.25	10	2.12	0.033	2.19	0.030	2.11	0.044
2.25	11	2.26	0.032	2.20	0.037	2.27	0.038
2.25	13	2.28	0.055	2.19	0.088	2.24	0.076
2.25	16	2.23	0.044	2.25	0.049	2.07	0.039
2.75	1	2.86	0.037	3.01	0.048	3.05	0.051
2.75	2	2.80	0.036	2.66	0.054	2.73	0.052
2.75	3	2.86	0.031	2.47	0.044	2.56	0.035
2.75	4	2.82	0.021	2.97	0.024	2.76	0.028
2.75	5	2.66	0.023	2.37	0.040	2.61	0.040
2.75	6	2.73	0.027	2.64	0.033	2.60	0.042
2.75	7	2.82	0.026	2.49	0.043	2.57	0.045
2.75	8	2.84	0.021	2.72	0.036	2.85	0.030
3.00	1	2.96	0.069	2.79	0.075	2.89	0.083
3.00	2	3.18	0.060	3.06	0.077	3.10	0.064
3.00	3	2.96	0.050	2.92	0.062	3.07	0.064
3.00	4	3.12	0.052	3.06	0.073	2.96	0.069
3.00	5	2.89	0.044	2.76	0.054	2.75	0.047
3.00	6	2.88	0.044	2.87	0.058	2.92	0.052
3.00	7	3.14	0.033	2.77	0.033	2.80	0.034
3.00	8	3.04	0.024	3.04	0.028	2.88	0.039
3.00	9	3.07	9 021	2.92	0.025	2.84	0.031
3.00	12	2.99	0.046	2.81	0.067	2.74	0.081
3.00	13	3.03	0.030	3.09	0.064	2.93	0.082
3.00	15	3.45	0.061	3.09	0.084	..	....
3.00	17	3.03	0.023	2.92	0.037	2.73	0.051
3.00	18	2.92	0.027	2.61	0.048	2.53	0.040
3.00	19	3.25	0 047	2.98	0.059	2.81	0.060
3.75	1	3.75	0.033	3.62	0.046	3.57	0.041
3.75	2	3.99	0.029	3.67	0.042	3.76	0.036
3.75	3	3.75	0.027	3.49	0.044	3.35	0.046
3.75	4	3.90	0.035	3.43	0.063	...	....
3.75	5	3.84	0.036	3.67	0.052	..	....
4.25	1	4.27	0.035	4.16	0.040	4.24	0.036
4.25	2	4.12	0.038	3.79	0.061	4.09	0.045
4.25	3	4.27	0.026	3.93	0.029	3.87	0.052
4.75	1	4 75	0.040	4.38	0.046	4.39	0.041

yond the perpendicular to the track of the crane runway. Thus, in dumping the boxes of iron into the block they would lack 5 or 6 ft. of reaching the outer edge of the block, making it impossible to distribute the iron as uniformly as desired throughout the block. A thorough discussion of the variations in sulphur is omitted, as I believe it wiser to try to solve one point at a time. Furthermore, the solving of the one question will help in the solving of the other.

Remedy in Better Mixing of Product.

The record of the 368 cast analyses corroborates the frequent experience of a single cast of iron varying widely in its silicon and sulphur contents. Some years ago the writer had occasion to investigate the variations and segregation of the elements and metalloids in iron and steel, and one instance came to his notice of a single half pig showing a variation of 1 per cent. (100 points) in silicon in the drillings taken from different parts of the half pig. If this be possible, where shall we look for a remedy—in the furnace or in the resultant product? A number of factors are involved in furnace operation, any one of which might be influential in effecting the variation of the silicon or sulphur contents of an individual cast, and all of which are beyond the furnaceman's control. The action of the iron in a furnace as it comes down from the zone of reduction into the hearth of the furnace might be compared, I think, with the action of the dropping very gently into a vessel of molten substance of high specific gravity some molten substance of like specific gravity. The two will not become thoroughly mixed. If it were possible to devise some means by which the metal in the hearth of the furnace could be mechanically mixed the resulting cast would probably be found more uniform, except for the carbon, as this would still be affected by the difference in the chill.

On the other hand, if we were to look to handling of the resultant product for a corrective of the differences I believe we would be taking a more reasonable course. With this in mind the writer made a change in the manner of mixing the iron entering into the various blocks, though this was done at the expense of 5 or 6 ft. of space on either side of the iron yards. So now the iron entering into any specific mixture is distributed evenly throughout the surface of the block, and a block when completed might present the appearance of a huge square layer cake of which the carloads are the slices.

THE FUTURE OF THE STEEL FOUNDRY.

Following on the article by W. A. Herron, in the March issue of the Foundry Journal, the writer noticed the article by W. Peters on "Moulds for Steel Castings."

We are continually being told that the foundry, as an indispensable unit of modern engineering, has not kept pace with the other branches. If this is a fact, the fact has become to some extent modified with the advent of effective foundry literature, which will always call forth the best opinions of those most closely allied to the trade.

Your correspondent states that "owing to the increasing knowledge of treating the *vagaries* of steel, the number of wasters in steel casting is decreasing."

I beg to substitute the term irregularities for vagaries, and to state that they do not exist in the steel, but in the methods of manufacture, after treatment and moulding generally.

As apart from moulding, steel founding may well be taken as the most vexed question in the whole realm of modern engineering, and we, in England, have recently seen the failure of more than one steel foundry, whilst, without doubt, in many other works, the steel foundry is a pitiable item of cost.

True, advances have been made in steel foundry practice, but considering the great possibilities of the trade, and the wide application of the product, we can scarcely claim to be out of the wood.

One of the chief reasons for this slow advance is the deplorable conservatism of those in a position to discuss the many problems existing in the trade. Another reason is that although we have got foundry literature galore, English and American, a careful review of even the most recent contemporary publications will show that only the most meagre and unsatisfying references are made to actual practice in the steel foundry, except here and there an elaborate description of moulding some particular job; this will avail little, and until we have an unstinted and candid exchange of opinion, through the press, of those skilled in the higher branches of the trade, we shall be little better off.

I submit that the salvation of the steel foundry lies in the application of metallurgy and chemistry to the existing and improving methods of engineering and moulding.

There is so much difference in the chemical composition and physical con-

stitution and behaviour of steel, as compared to iron, that any attempt to improvise iron foundry methods and apply them to the practice must result in failure.

The present high price of steel castings is the best criterion of the bitter experience of steel founders in the past, and shows that any advance has been made on the lines of error and loss.

Your correspondent uses the old fleeting definition of the Tropenas' process, viz., "a modification of the Bessemer"; it is more than this, it is a process which, in the hands of an intelligent metallurgist in a well-conducted foundry, is eminently suited for the production of steel castings in an establishment where the demand is intermittent and casting required at short notice. With this process it is easy to deliver an order the day following the receipt, where annealing is necessary, and the same day where not required.

Green sand moulding is an established fact, and owing to the higher temperature attainable, and the superior fluidity, thin castings impossible with other processes are possible here.

Taking even the most favourable and widely-adapted process, any moulder who has worked in steel and in iron will at once admit, that to produce even the simplest job in steel exactly as in iron is an impossibility. This may be quoting a truism, but it opens up a question which, to the intelligent workman, has never been answered to his satisfaction.

The value of steel relative to iron lies in its superior tenacity and ductility. It differs chemically, chiefly in its diminished quantity of carbon and silicon. The former difference is due to the latter, and the attainment of this peculiar difference involves the all-important process of steel manufacture.

The casting temperature must also increase as these elements diminish, and this in turn militates against the successful operation of moulding and casting.

In considering the fusing and casting temperature of steel, we are brought straightway to one of the main differences between iron and steel casting, viz., contraction and its attendant evils. The fusing point of steel varies from 1,400 to 1,500 degrees Centigrade; to cast well it must be raised considerably higher than this, and often reaches 2,000 degrees. A glance at the co-efficient of expansion of iron for heat will show that this works out to nearly 2 per cent. contraction of volume, that is, a liner 20 ft. in length at the moment of casting will measure, when cold, nearly 5 in. less, irrespective of any lateral shrinkage. This considered, no question would be asked if the casting, in the absence of facility for contraction, were pulled in two.

Piping is another effect traceable to this cause, though not necessarily, as a dead soft steel poured at a higher temperature than one containing more metalloids will pipe less.

Few steel founders have not deplored the disastrous effects of shrinkage holes in castings otherwise perfect, and discovered only in the last few cuts of the machine tool when all the cost of machining and labour have been wasted.

Shrinkage holes are internal pipes, pure and simple, and it is only by judicious heading or feeding, and control of the casting temperature, that they can be avoided. A perfect system of heading would remove the evil completely; this, however, is impossible, whilst the latter, so far as the steel work is concerned, has received little or no attention. Much has been written of late about casting temperatures, but considered in this light alone the importance becomes paramount. The practical point is that for any volume of steel at constant temperature and composition, the shrinkage is the same. It is a phenomenon governed by the most immutable of physical laws.

The higher the temperature the greater the shrinkage and volume of the pipe. Heading can only alter the *position* and not the *volume* of the pipe, *i.e.*, bring it higher up and out of harm's way.

Quoting again from the May issue of your excellent journal, we read, "The uncertainty attending the making of steel castings has to a great extent disappeared, and steel castings are now produced free from the defects of blow-holes and brittleness."

My own experience as regards the latter statement is that although true in fact it is not true in the main, and that though possible to produce castings free from either defect, the production is attended with uncertainty and out of all proportion to what must be our aim.

Recent scientific investigation has shown that it is possible to produce steel entirely devoid of blow-holes or blow-hole forming tendencies (for it must be understood that steel can acquire blow-holes apart from what is actually taken up in the furnace).

The two main antidotes for the illumination of blow-holes in steel are, as is well known, silicon and aluminium.

Judiciously applied, the harmful effect of blow-holes can be entirely overcome by these substances, and it is by the in-

judicious use of them that much of the brittleness observed is brought about.

The early struggles of the steel founder consisted in finding a suitable sand or mixture of refractory materials sufficiently refractory to withstand the intense heat of the molten steel without erosion, and yet sufficiently plastic to retain its form while drying at the temperature sufficient to drive off all the moisture, the presence of which is so fatal to the successful casting of the mould. This was a costly problem, and has resulted in the establishment of several good brands of "compo," the chemical composition of which can be no secret, but no amount of chemical compounding of refractory materials can produce an actual imitation, as they are produced chiefly from *natural* rock mixed in varying proportions. The question of sands is of vital importance to the steel founder, and the writer's experience is that any steel foundry depending for its "facing sand" on the compos of commerce is working at a loss in that respect. It is well known that no specific brand or mixture is adaptable to all classes of work, and as, with suitable grinding and mixing machinery, it is possible to produce facing sand of strength and refractoriness to suit any job, no foundry should be without such facilities.

All facing sands used for steel moulding at the present day contain silica as the main ingredient varying from 80 to 90 per cent., and recently even more than 90 per cent.; next to silica in importance is alumina, which is added in the form of argillaceous materials, such as clay; this latter, together with silica of varying purity, carries into the mixture impurities such as ferrous and ferric oxides, or oxides of iron, lime and alkalies, quantities of which above very narrow limits are fatal. Where the cost of transport precludes the use of natural sands, facing sands approaching them very nearly in composition can be made by mixing quartz sand and analogous substances with pure fireclay in suitable proportions, opened up by means of carbonaceous matter in divers forms.

The principal properties of the mixture, as affecting the porosity of the mould, is not to be lost sight of, as my experience is that two sands may be practically the same in chemical composition, and yet one of them be so non-porous as to be practically unfit for use without opening out, and too rigid to use in any job where contraction must take place before it is possible to "ease" the casting. It is common knowledge that in some of the complicated designs met with in modern high-class work many parts of the mould have to be made self-easing, and in many cases the use of cinders and other collapsible devices are not permissible.

After treatment is a subject of such importance in the steel foundry that it deserves to be discussed probably more than any other, since nearly all steel articles now made are subjected to some form of heat treatment before being delivered as finished.

The principal item under this category, so far as the steel foundry is concerned, is that of annealing.

The very best of steel is worthless unless subjected to some form of annealing, and yet the very best authorities on the subject differ in their views as to the correct rationale and *modus operandi* of this important operation.

Some workers regard annealing as heating the castings to a temperature of about 725 degrees Centigrade, others to a temperature below this, whilst in many works 900 degrees Centigrade is sworn by. Some cool their steel rapidly; some make the gradual heating and cooling extend over a period of three days, and even five days; some anneal in covered boxes with or without packing of protective material.

This variation of practice can only accrue from the lack of definite views on the subject, and yet this operation, like all others in the steel foundry, is governed by laws and principles thoroughly understood and capable of control.

It should be clearly understood that for every steel of definite composition (principally with regard to carbon content) there is a certain and definite annealing temperature, yet in my experience in establishments of high repute I have seen castings varying in composition from 0.6 per cent. carbon down to dead soft variety, thrown indiscriminately into the annealing furnace, and that without regard to the question of thick and thin sections which, as is well known, is an important one from a point of view of the time element.

It goes without saying that there is many an otherwise splendid and costly casting ruined by careless and erratic annealing.

So increasingly important is this question that I can only urge your readers to discuss it and other relative subjects through the press to the advantage of all concerned.

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MESSRS. ALFRED DICKINSON & COMPANY, consulting engineers, have removed their London establishment to 210, Gresham House, Old Broad Street, E.C.

NEWTON'S MOULDING MACHINE

A SPECIFICATION* in the name of H. E. Newton, London, was published last month and describes "Improvements in Moulding Apparatus for Casting in Metal." We reproduce Figs. 1 and 2 of the drawings, and these, with the description taken from the specification, will explain the working of the apparatus.

Fig. 1 is a side elevation, showing a vertical arrangement of mould in the open position.

Fig. 2 is a left-hand end view.

A is the fixed half of the mould mounted on the base B to which the side frames C are secured in any convenient manner. The top surface C^1 of each frame forms a path for rollers, while the inclined face C^2 of the side frame forms a path for other rollers. D is the movable half of the mould which consists of a suitable casting provided externally with stud axles on which rollers E and F are mounted. The rollers E run on the surface C^1 and the rollers F on the inclined face C^2. G are handles on the part D, and H and H^1 are pins, the use of which will presently be described. By pulling forward the top of the part D by the handles G the rollers E will be caused to run down the curved surface C^1, and the rollers F to run up their inclined face C^2, as seen in Fig. 1. A pivoted counterweighted catch J is provided to pass under the axles of the rollers F, and the part D will thus be locked firmly in the horizontal position at a convenient height for placing the matrix in the part D.

K are hinged side gauges, which are opened to allow of fitting in the matrix and then closed to secure its edges, and at the same time serve to centre the matrix in the part D; the matrix is not shown in the drawings.

L is a strap or root gauge provided with two handles, and it is secured in any convenient manner in the part D and serves to clip the bottom end of the matrix. This strap L also forms the bottom of the mould when the parts are together in position to receive the metal. When the matrix is properly arranged and fixed in any convenient manner, the part D is moved or rocked into a vertical position by means of the handles G, which will bring the pin H^1 into the jaws of the cam piece M and the pin H into the path of the slot cam N.

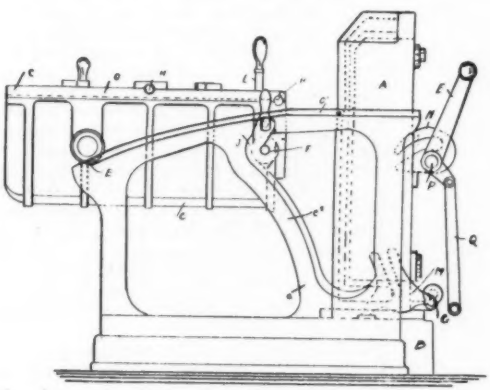

FIG. 1.

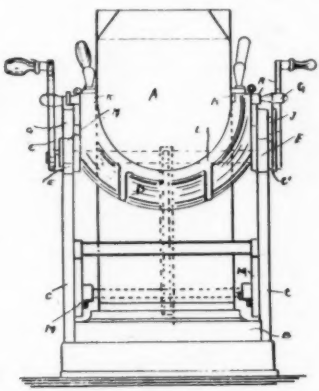

FIG. 2.

NEWTON'S MOULDING MACHINE.

The cam piece M is pivoted to an arm on the rocking shaft O, while the cam N is mounted on the shaft P. These two shafts, O and P, are connected together by the link Q, and are operated by the handles R on the shaft P.

When the part D is in the vertical position the handle R is swung to the left, which causes the slot of N to pass over the pin H, and as the movement continues the part D will be drawn close up to the part A with a parallel motion, due to the action of the two cams M and N. The cam M has a sliding movement, which acts to draw forward or press backward, as the case may be, the lower end of the part D, and assist in producing the parallel motion before described.

* No. 15,536 of 1904.

CASTING MOTOR CAR CYLINDERS.

According to a recent patent by Wilson L. Fenn and John W. Conway, of Hartford, Conn., U.S.A., a process of fusing together two or more metals, one of which is relatively thin, and particularly when the thinner metal fuses at a lower point than the metal with which it is united, is practicable for the production of cast-iron cylinders for air-cooled petrol and other engines. The principal object in this case is to provide the cylinders with thin projecting fins, preferably of sheet copper,

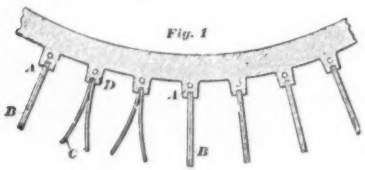

Fig. 1

Fig. 2

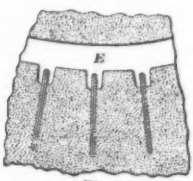

Fig. 3

for increasing the heat radiating surface of the cylinder.

Fig. 1 is an end view showing in transverse section a fragment of an engine cylinder having fins of sheet metal fused to it. Fig. 2 is a side view of a portion of one of the fins. Fig. 3 is a sectional end view of a fragment of the mould into which the cast iron is poured, and shows some of the sheet-metal fins in position in the mould. In making air-cooled cylinders, particularly for automobiles, it is necessary to secure these fins firmly into the cylinder on account of the jarring to which they are subjected. It is therefore desirable to fuse them into the cylinder rather than to hold them in by pinching or a similar mechanical means. The difficulty in fusing them in place arises from the fact that the heat of the molten body of the cylinder is high enough, and by reason of its usual bulk holds long enough to melt off the enclosed base of the strip, disintegrating the structure of the metal, and if the strip continues to hold it all it does so only by an area equal to its thickness as though it had been brazed edgewise against the outer surface of the cylinder.

In the present invention the fins are seated in ribs projecting from the main body of the casting and proportioned to retain the heat long enough to secure fusion between the casting and the strip without melting off the base of the strip. The outer surface of the cylinder has ribs at A to receive the bases of the fins B. The projecting ribs A chill much more quickly than the greater mass of the cylinder wall, and they are to be so proportioned that they begin to chill as soon as the fins are properly fused to the ribs. The fins here illustrated are doubled on themselves and extend lengthwise of the cylinder. When doubled in this manner, the strips may be separated afterward on their ends, as at C, and thereby increase the radiating surface. As a further means of ensuring the retention of the fins in place they are provided with a row of holes D near their folded base portion. The surface of the sheet metal could be corrugated for the same purpose. Fig. 3 shows a portion of the mould ready for the casting of the cylinder seen in Fig. 1. The space E receives the body of the cylinder wall, and the projecting ends of the fins B extend into the recesses formed for the ribs. In practice, the inventors say, it has been found convenient to place the fins in the pattern before the latter has been placed in the flask. After that the sand may be rammed into place and the pattern withdrawn, leaving the fins in position as shown.

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The late Sir Bernhard Samuelson, chairman of Sir B. Samuelson & Company, Limited, left estate of the gross value of £755,793.

The examination in bankruptcy of Carrick & Topping, electrical and mechanical engineers, Glasgow and Dumfries, has been closed. The state of affairs showed liabilities amounting to £774 10s. 10d., and assets £363 15s. 8d., the deficiency being £410 15s. 2d.

The agency for Great Britain and Ireland for part of the manufactures of the Mülheim Works (Carlswerk) of Messrs. Felten & Guilleaume-Lahmeyerwerke, has been transferred to the Lahmeyer Electrical Company, Limited, 109-11, New Oxford Street, London W.C.

PICKLES' SAND-MOULDING MACHINE.

Messrs. James Pickles, Limited, Victoria Works, Bradford, are introducing a patent sand-moulding machine which will be of particular value on small jobs, such as are made by plate work. Two illustrations of the machine are given, Fig. 1 showing the mould being pressed, and Fig. 2 the mould being withdrawn. In the invention on which this appliance is based, the sand may be rammed into the box either by hand or by a machine press, the pattern plate and mould box being turned over,

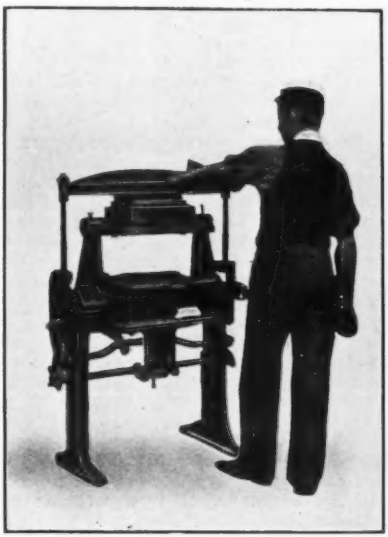

Fig. 1.

Fig. 2.

Pickles' Sand-Moulding Machine.

and the mould mechanically withdrawn vertically downwards without breakage of the sand, a clean mould resulting. Usually the pattern has to be lifted out by hand, with resultant breakages. A table, mounted on bearings and capable of being turned over and retained in horizontal position, is added to a presser head, a lifting table being also supplied for withdrawing the mould, and the claim is for the combination of the presser head and the two tables. Screw regulation is supplied to suit the depth of the box. The action of the machine is as follows:—The flask is placed on the turn-over table attached in the usual way, and filled with sand. The pressure head is then brought over the mould by the lever on the right-hand side, and the sand is easily pressed home. To do this, the moulder simply puts his weight on the lever, which is in a horizontal position. The lever is then lifted, the presser head being thereby moved clear of the flask and table. The latter is then turned over, and the lever on the left of the machine is used to raise the under-table and pin the flask from the under side. The flask is then released from the turn-over table, and, a few sharp raps being given to the pattern plate, the lever is brought back into its first position, the under-table and flask are withdrawn, and the mould is obtained. It will be seen that no stripping plate is used and that hand ramming is unnecessary. It is also claimed by the makers that with a few hours' practice any inexperienced youth can work the machine satisfactorily, and that in plate work the machine will do one-third more than any hand machine made, while it will do all that can be obtained from a hydraulic machine without the cost of hydraulic plant. Where necessary, the parts are protected from dirt. Both motions are balanced by weights, the vertical rise to the presser head being guided by rollers, and the lifting table being guided by a hexagon-shaped slide under its centre. The lifting table in particular is so balanced.

HARD CAST IRON.

By Henry Souther.

A consulting metallurgical engineer in contact with machine shops is accustomed to hearing complaints from the operators of machine tools of hardness of material being machined. Sometimes it develops, especially with steel, that the trouble is not that the steel is hard; but, on the contrary, that it is exceedingly soft. The softness is of such a character that the edged tool does not succeed in cutting the steel keenly, but rather tears it off, some of the particles clinging to the edge of the tool, causing excessive friction and rubbing, and drawing the temper of the tool and dulness soon follows. The effect as far as the machine operator is concerned, is that of a hard steel; the tool is spoiled. This not only applies to low carbons, but to a peculiar physical condition of higher carbons, say, in the neighbourhood of .50, due to bad annealing.

Then there is the legitimate hard steel, which is really hard in the true sense of the term.

Cast iron that chills may be called hard in the truest sense of the word. That is the complaint that is most often met when the term hardness is used in connection with machining cast iron. Iron chills because of high sulphur or low silicon, or a combination of both, and machine tools simply can not cut it. This kind of hardness is more often found in thin work than in thick work. For example, the hardware people casting very thin material have to use the softest of iron, high silicon and low sulphur, in order that the small amount of machining they do may be done at all.

In the last five or six years three separate complaints of hard iron have reached the writer and proved of so baffling a character that in each case visits were made to the machine shops working the iron, and the complaint carefully investigated. Analysis or test did not reveal the cause.

The most instructive case covers them all. This instance was most informing, because it occurred on a multiple drill where several different sizes of standard drills were used and several thicknesses of metal were involved. On approaching the machine it was noticeable at once that there was trouble, because the drills were screeching in an unusual way.

It developed that small drills, ¼ in., or thereabouts, were standing up with this iron just as well as any other, but the larger drills in the neighbourhood of ½ in. and ¾ in. were dulling exactly as though the iron were charged with emery. The edges were being ground off, and would last only a fraction of the time usual for the same drills in the same machine.

Here was an unusual condition—thin iron working easily; thick iron on the same castings working with difficulty.

The chemical results were normal, except manganese—silicon 2.50, phosphorus .70, sulphur about .080, total carbon 3.50 and manganese .16.

The fracture of the iron was good, and, moreover, it was quite normal as far as could be seen with eye or microscope. A Keep's test drill was used and developed nothing unusual, no signs of hardness, thick and thin iron showing a normal curve. There was no opportunity to test the tool wearing qualities on the Keep machine, because the drill was sharpened after every hole drilled.

Inasmuch as the only abnormal part in the analysis was shown in the manganese, that element was suspected, although there seemed to be no metallurgical reason for so doing. Means were taken to raise it to the neighbourhood of .50, and as soon as this was done the difficulty disappeared in the machine shop and has not reappeared after some months.

It is a complaint which reached me, as I said above, from two other sources, and in both of those sources the complaint was described by the machine shop people by saying that the iron was "gritty." They were fully convinced that there was sand in it, but examination showed that to be out of the question, and the iron was as clean as any iron.

This leads me to believe that there must be some carbide of iron or carbide of silicon that forms in the absence of a reasonable amount of manganese, and that does not form with manganese present. What this chemical combination may be I cannot surmise, but the problem presented is an interesting one from a theoretical and practical standpoint. Apparently its cure has been found, but the question remains, Why?

The actual castings causing this trouble were put through, and no specimens kept, so that the writer can furnish no samples for study.

* Presented at the Atlantic City meeting of the American Society for Testing Materials.

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Whitfield's Foreign Patents, Limited, is the style of a company formed with a capital of £22,500 in £1 shares, to carry on the business of iron and steel founders, etc.

THE ALUMINO-THERMIC PROCESS IN THE MANUFACTURE OF INGOTS OR CASTINGS.

THE application of Thermit to the production of sound castings of iron and steel is one of profound interest to the metallurgist. There is no doubt that Thermit, Limited, have had considerable success in this direction, as can be seen by an inspection of some samples at 27, Martin's Lane, Cannon Street, E.C., where their offices are located. Thermit, of course, is made of powdered aluminum and iron oxide or any other oxide, from which it is intended to extract the metal, and possesses the property that, when once ignited, say at a corner, the ignition propagates itself through the whole mass with the following results:—

1. Development of a high temperature.
2. The reduction in its liquid state of the metal from the metallic oxide, mixed with the powdered aluminum.
3. The burning of the metal aluminum to its oxide alumina, obtained in its molten state under the shape of artificial corundum.

The most important quality of this mixture is, however, that it burns without requiring the use of any additional gas, and that its products of combustion contain no gases. It is this last property that makes very valuable the application of Thermit to foundry purposes, with the special aim of obtaining sound castings free from blow holes.

Thermit, with an addition of a small quantity of oxide of titanium, which for the purposes of this article may be called "Titan-Thermit," is used for the prevention of blowholes in iron or steel castings.

For this purpose it is supplied in tins of various sizes, according to the quantity of metal to be treated. The tins are made with a hole in the centre through which an iron rod is passed, so that it projects about 4 to 6 in. beyond the bottom of the tin, and is firmly kept in position by winding a few turns of wire around the rod immediately above and below the tin. (Fig. 1.)

The tin is then introduced into the ladle immediately after the metal is run from the furnace, and held steadily at the bottom until the reaction, which is at once set up, ceases.

This is easily judged, as the reaction causes a strong "boiling" action throughout the metal, mixing it and assisting the escape of gas and metallic oxides, and at the same time distributing the titanium evenly throughout the mass, thus alloying it in with the metal to be treated.

The effect of the titanium is to combine small quantities of nitrogen, increase the fluidity of the metal and produce a finer grain. An increase of the temperature does not, in reality, take place, as the proportion of added Thermit is only from $\frac{1}{16}$ to $\frac{1}{4}$ per cent. of the total contents of the ladle.

The reaction also has the effect of reducing the sulphur contents, as is indicated by the following tests, which also

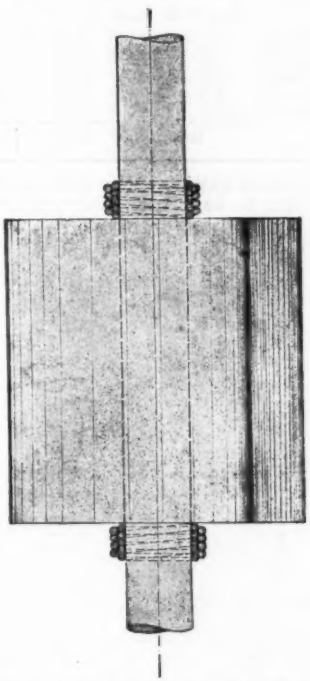

FIG. 1.—SHOWING TIN FIXED ON ROD.

show that traces only of titanium can be found in the metal after treatment.

No. 1.		
Cast-iron before treatment.		After treatment.
Mn.	0.36	Mn. 0.30
S.	0.09	S. 0.09
Ti.	—	Ti. traces
No. 2.		
Before treatment.		After treatment.
Mn.	0.65	Mn. 0.64
S.	0.09	S. 0.07
Ti.	—	Ti. traces

The following are the results for a series of test bars taken from malleable castings

with and without the addition of "Titan-Thermit":—

Without "Titan-Thermit."

—	Dimensions.	Ultimate strength in lbs.	Deflection.
			in.
No. 1—1...	1.000 × .999	4,100	1.00
„ 1—2...	.995 × .999	4,590	.98
„ 1—3...	Lost in anneal.		
„ 2—7...	1.000 × .993	4,540	1.28
„ 2—8...	1.012 × 1.006	4,610	1.40
„ 2—9...	1.006 × 1.005	4,500	1.40
	Average without treatment	4,450	1.212
	With "Titan-Thermit."		
No. 1A— 4	1.011 × 1.010	5,920	1.30
„ 1A— 5	.999 × 1.000	4,260	1.27
„ 1A— 8	.989 × .995	4,850	1.55
„ 2A—10	.995 × .996	4,620	1.47
„ 2A—11	.998 × .996	4,410	1.37
„ 2A—12	1.011 × 1.000	4,810	1.44
	Average with treatment	4,811	1.40

For small castings, where the quantity of metal to be treated does not exceed

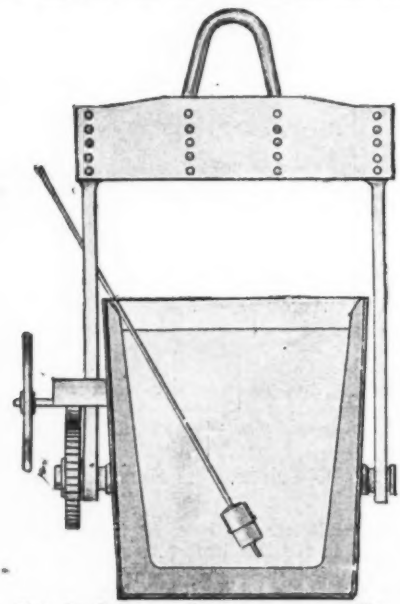

FIG. 2.—SHOWING INTRODUCTION OF TIN INTO LADLE.

5 cwt., the tin is dispensed with and "Titan-Thermit," in the form of powder, is then wrapped in a piece of paper, with about a teaspoonful of ignition powder and placed at the bottom of the ladle before pouring. In this case the quantity of the compound should not be less than ½-lb. for quantities of metal up to 2 cwt. and about 1 lb. for 5 cwt., and the reaction should not subside until the whole charge is in the ladle. After treatment the metal will show a slightly lighter

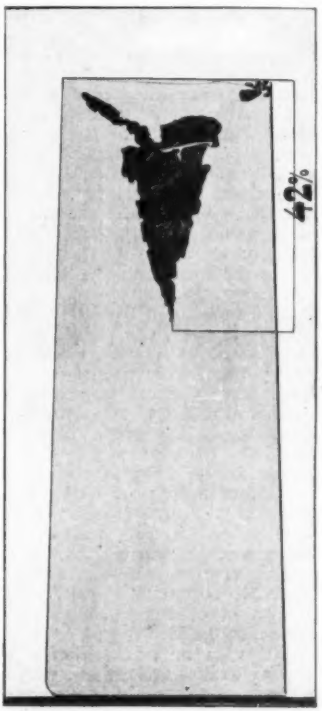

FIG. 3.—STEEL INGOT SHOWING DEFECTIVE HEAD PIPING WITHOUT ANTI-PIPING THERMIT.

colour when poured from the ladle. The process is equally applicable to iron and steel castings, but in the latter case no ignition powder is required, as the temperature of the metal is sufficient to start the reaction. The use of the compound is not, of course, intended to replace ordinary sound foundry practice, but is an aid to the expert iron founder to help to overcome difficulties otherwise beyond his control.

In order to obtain the best results in the use of this compound the tin should be firmly attached to the iron rod, which must project a few inches beyond the bottom of the tin in order to prevent its coming in contact with the bottom of the ladle. The rod and tin should be warmed

before plunging into the metal. The tin is plunged to the bottom of the ladle immediately the latter is filled, and held steady till the boiling action subsides. When treating large quantities of metal the rod will tend to buckle and the tin to rise. This can be overcome by turning the rod in the ladle. As soon as the reaction subsides the rod is withdrawn, the slag skimmed off, and the procedure is then as usual.

Thermit, without addition of titanium, is also of advantage, where long and intricate castings are being dealt with, to revive the metal which may have become sluggish in the moulds. To overcome this a tin of the compound may be inserted in the riser in the same manner as described above, or, as is now frequently practised by works in this country, by dropping the Thermit powder wrapped in a piece of paper on to the liquid metal as it mounts in the riser, before it gets into the rising head. The reaction reheats the metal and renders it more fluid, allowing it to flow back, thus preventing flaws due to shrinkage, and ensuring a perfect casting. The method is frequently used even for small castings.

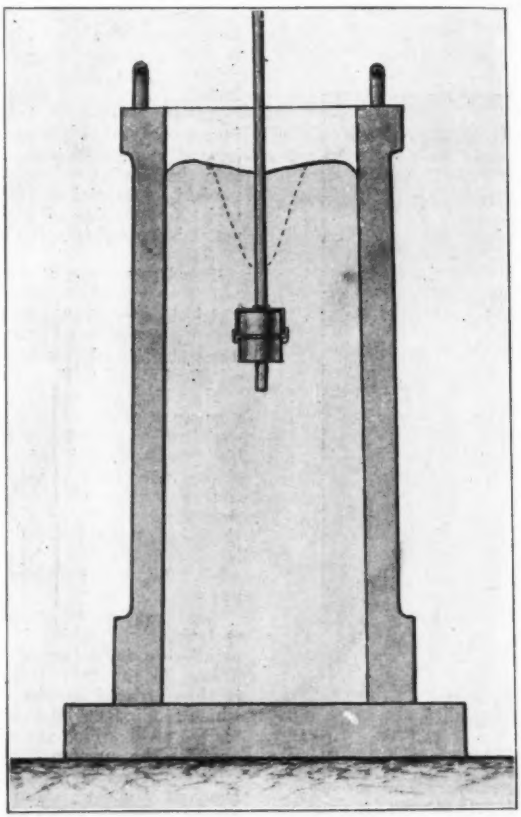

FIG. 4.—STEEL INGOT WITH BOX OF ANTI-PIPING COMPOUND IN POSITION.

Filling of Blowholes in Castings.

Blowholes and flaws in iron or steel castings can be quickly and effectively filled with Thermit iron, so as to render faulty castings perfect. For this purpose the compound is ignited in a special crucible

with a flat bottom, a small quantity being first ignited and more of the compound added as soon as the reaction subsides. After the desired quantity has been brought to reaction, the slag, which covers the molten iron, is rapidly poured off on to dry sand, and then the iron is poured into the hole to be filled, which must, however, have been previously cleaned and heated so that it is warm to the hand. The temperature of the Thermit iron is such that it will melt the walls of the

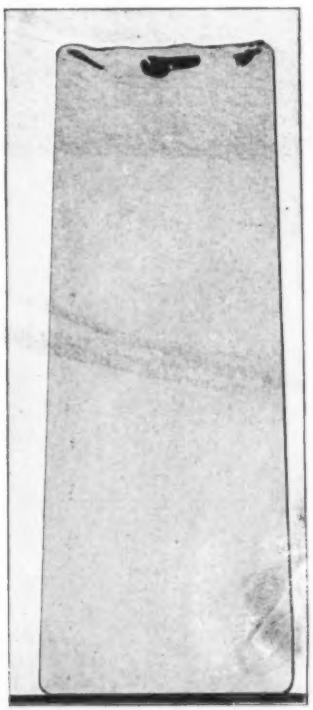

FIG. 5.—TWENTY-TON STEEL BLOCK HAVING BEEN TREATED WITH ANTI-PIPING THERMIT.

hole and make a perfect weld. For the filling of large holes another method can be adopted, using a so-called automatic crucible (with taphole at the bottom). In this case it is necessary to first calculate approximately the quantity of metal necessary to fill the hole, twice this amount of the compound is then placed in the crucible, the hole to be filled is surrounded by a dry mould, and the crucible placed in position on a tripod with the taphole about 4 in. above the top of the mould. The compound is then ignited, and as soon as the reaction subsides the crucible is tapped allowing the Thermit iron to flow directly into the hole; the slag which will fill the mould is then removed and the metal hammered down while hot.

Manufacture of Small Castings.

Where small steel castings are required in a hurry, the Thermit compound offers a means of obtaining what is required without the help of a fully-equipped foundry.

About 25 per cent. iron or steel punchings are added to the compound, which is ignited in an automatic crucible and run into the mould: the reaction may also be made in a special flat-bottomed crucible, and after pouring off the slag the liquid metal is poured into the moulds.

The Prevention of Piping in Large Steel Ingots.

Another application of the compound has been found in the manufacture of large steel ingots to prevent the familiar effect of "piping."

The Thermit process as used for this purpose consists of introducing a tin of so-called anti-piping Thermit into the block with the aid of an iron rod in a similar way to that described before for the prevention of blowholes in castings. According to the size of the ingot the tin is inserted about 3 ft., after the piping is formed, the head layer, which has become solid, being broken through for the purpose.

The reaction commences immediately, and the metal which is on the point of solidifying is re-heated and flows down, filling up the cavities formed. A space is thus created at the top of the ingot which is filled up by the addition of more molten steel, which must be kept in readiness for the purpose.

The method is very simple, and moreover, very cheap; about 20 lbs. of anti-piping Thermit being required for a 15-ton ingot.

After the treatment relatively very small flaws are found, and these only in the upper part of the ingot.

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MR. W. F. SMITHERS and MR. A. JEYNES, lately connected with Ashmore, Benson, Pease & Company, Limited, Stockton, have formed a limited liability company, and acquired the Tees Foundry and Engineering Works, Cargo Fleet, Middlesbrough.

TRADE TALK.

THE new engine works at South Shields of Smith's Dock Company, Limited, are now in operation.

MR. J. W. BROWN, engineer, of Victoria Street, Westminster, S.W., has been adjudged bankrupt.

MESSRS. HOME & ROWLAND, of Troughton Road, Old Charlton, S.E., are extending their works.

THE WORKINGTON IRON COMPANY, LIMITED, are shortly starting the manufacture of ferro-manganese.

THE new plant at the iron works at Lea Brook, of John Bagnall & Sons, Limited, is working satisfactorily.

MESSRS. CARTER & HORSFALL, engineers, Nelson and Brierfield, Lancashire, have dissolved partnership.

IT has been rumoured that the Armstrong Whitworth Company are acquiring the Carron Iron Works, Falkirk.

MESSRS. R. THOMPSON & SONS, of the Bridge Dock, Sunderland, have recently added a new machine shop to their works.

THE average net selling price of finished iron in Scotland for May and June last was £5 15s. 2.28d. per ton at works.

RADCLIFFE ENGINEERING WORKS, LIMITED, has been registered with a capital of £20,000 in £1 shares (5,000 deferred).

MR. H. E. TILSON has been taken into partnership by Mr. J. E. Muir, consulting engineer, 105, West George Street, Glasgow.

A RECEIVING order has been made in connection with the affairs of A. J. Harris & Company, electrical engineers, Bradford.

THE EXPRESS STEEL WORKS, Cwmavon, were the scene of a serious fire recently, damage estimated at from £300 to £400 being done.

A. FINDLAY & COMPANY, LIMITED, of Motherwell, have established a branch office at 9, Victoria Street, Westminster, London, S.W.

NEGOTIATIONS for the acquisition of ground in Greenock or Port-Glasgow, on which to erect new engineering works, are in progress.

MESSRS. R. E. WATSON, G. W. WATSON, and J. H. WATSON, engineers, of Leeds, trading as J. B. Watson & Sons, have dissolved partnership.

WOODS & COMPANY, LIMITED, have acquired the ironfoundry and engineering business carried on at Stowmarket, Suffolk, as Woods & Company.

A RECEIVING order has been made in connection with the affairs of Mr. L. Tolch, trading as Tolch & Company, engineers, of Putney and Fulham.

AN international committee has been formed for investigating the constituents of steel at the instance of Professor R. T. Glazebrook and Mr. H. le Chatelier.

A DISSOLUTION of partnership is notified in connection with Messrs. F. W. R. May and E. G. K. Calder, electrical engineers, Newington Causeway, S.E.

THE MUNICIPAL FOUNDING AND ENGINEERING COMPANY, LIMITED, with offices at Wombwell, near Barnsley, has been registered with capital of £5,000.

HOWARD T. WRIGHT BROTHERS, LIMITED, has been formed to carry on the business of engineers, etc. The capital of the company is £10,000 in £1 shares.

THE creditors of A. Nisbet & Son, ironfounders, 100, Portman Street, Glasgow, have decided to wind up the business under the trust deed. The liabilities are £15,417.

JOHN SUMMERS & SONS, LIMITED, Globe Iron Works, Stalybridge, have appointed Messrs. Stedman, Crowther & Company, 233, St. Vincent Street, Glasgow, as their Glasgow agents.

THE new plant at the works of Charles Roberts & Company, Limited, Horbury Junction, near Wakefield, for the manufacture of wheels and axles, is now practically completed.

THE NEW CENTURY ENGINE COMPANY, LIMITED, have taken over the whole of the undertaking and the assets of the New Century Engine (Foreign Patents) Company, Limited.

GUEST, KEEN & NETTLEFOLDS, LIMITED, have decided to erect, at their Dowlais Iron and Steel Works, two or three blast furnaces and other plant at an expenditure of a quarter of a million.

MESSRS. T. W. GREENWELL & COMPANY, ship repairers, Thornhill Quay, Sunderland, will shortly remove to new premises, adjoining the Wear Commissioners' No. 1 graving dock.

SAMUEL FOX & COMPANY, LIMITED, are putting down new plant at their Sheffield works to deal with the requirements of engineers with regard to the heavier goods manufactured by the firm.

Messrs. Andrews, Davidson & Company, 126, Bothwell Street, Glasgow, have been appointed the Scottish representatives of Messrs. Dorman & Smith, of Ordsal Electrical Works, Salford.

The average ascertained selling price of manufactured iron in the North of England for the two months ending June 30 was £5 17s. 6.92d. per ton, as against £5 17s. 8.44d. per ton in the previous two months.

The board of directors of the Terni Steel Works have decided to form a new company for the manufacture of artillery and munitions of war, in which Vickers, Sons & Maxim, Limited, of Sheffield, are interested.

The Motherwell Iron and Steel Company, Limited, have terminated the agreement by which J. T. Donald & Company, Limited, act as their selling agents, and have opened offices at 118, Queen Street, Glasgow.

George Anderson & Company, Limited, has been registered with a capital of £75,000 in £1 shares, to purchase the business of George Anderson & Company, Limited, Taymouth Engineering Works, Carnoustie.

Messrs. T. Tolley, R. M. Tolley, W. H. Bostock, and G. M. Tolley, iron masters, Darlaston, Staffordshire, trading under the style of Tolley, Sons & Bostock, have dissolved partnership, so far as regards Mr. T. Tolley.

The Cardiff Rolling Stock Company, Limited, is the name of a concern registered, with a capital of £15,000, to carry on the business of railway wagon manufacturers, etc. The registered office is at the Works, East Moors, Cardiff.

Zschocke's Engineering Company, of Kaiserslautern, have appointed T. Sudgen, Limited, 180, Fleet Street, London, E.C., as sole agents in Great Britain and Ireland, having severed their connection with Messrs. Donat & Company, of Manchester.

A large double planing machine is being supplied by G. Richards & Company, Limited, Broadheath, Manchester, for the works of J. I. Thorneycroft & Company, Limited. The machine will deal with work up to 25 ft. long, 10 ft. wide, and 8 ft. deep.

The Grimesthorpe Steel Works, Sheffield, belonging to Cammell Laird & Company, Limited, are being very extensively improved, one of the chief additions being plant for producing the highest class of tyres for locomotives, carriages, and wagons.

OBITUARY.

Mr. F. G. Whitwham, a director of the Brymbo Steel Company.

Professor Franz Reuleaux, the German engineering specialist.

Mr. G. W. Jaffrey, engineer and shipbuilder, Greenock, in his 85th year.

Mr. D. Davies, proprietor of the Dunston Iron Works, at the age of 67 years

Mr. J. H. Hunt, one of the proprietors of the Chillington Tool Foundry, Wolverhampton.

Mr. A. N. Hopkins, of J. H. Hopkins & Sons, Limited, iron manufacturers, etc., Birmingham.

Mr. J. W. Russell Wall, of the firm of Messrs. Biggs, Wall & Company, gas engineers, Cross Street, London, E.C.

Mr. Robert Kerr, sen., who started the Irvine Forge Company in 1872, and later the Caledonian Forge Company.

Mr. T. Bradford, head of Messrs. T. Bradford & Sons, Crescent Iron Works, Salford, Manchester, at the age of 80.

Mr. C. Richards, sen., founder of the firm of Messrs. Charles Richards & Sons, bolt and nut manufacturers, Wednesbury, at the age of 68 years.

Mr. E. Skinner, of Ranskill, Retford, at the age of 74. The deceased gentleman founded the firm of Skinner & Johnson, tool manufacturers, Ranskill.

Mr. G. A. Everitt, of the well-known brassfounding firm of Allen Everitt & Sons, Fazeley Street, Birmingham, in his 83rd year. He was also a director of the Patent Shaft and Axletree Company.

Mr. David Evans, general manager of the iron works of Messrs. Bolckow, Vaughan & Company, Middlesbrough, in his 65th year. Mr. Evans was for 13 years general manager of the company's steel works at Eston, a position from which he only retired in November of last year. He was a Past-President of the Cleveland Ironmasters' Association, a member of the Council of the Iron and Steel Institute, a member of the Institute of Civil Engineers, a member of the Institute of Mechanical Engineers, on the Council of the British Iron Trade Association, a Vice-President of the Institution of Cleveland Engineers, a member of the American Institute of Mining Engineers, a member of the Institute of Naval Architects, the representative of the steelmakers of England and Wales on Lloyd's Committee, and a director of the New Cransley Iron and Steel Company, Limited.

PERSONAL

THE late Mr. R. S. Scott, engineer and shipbuilder, left estate of the gross value of £154,093.

MR. T. F. BRADBURY has been elected on the board of the Lancashire Wagon Company, Limited.

MR. I. WILLIAMS, of Middlesbrough, has been elected a director of Messrs. Bolckow, Vaughan & Company.

THE late Mr. T. K. Hill, proprietor of the Victoria Iron Works, Heywood, left estate of the gross value of £15,479.

MR. S. JESSOP ROBINSON, of William Jessop & Sons, Limited, has been installed as the new Master Cutler of Sheffield.

THE estate left by the late Mr. H. F. Hall, a director of the Yorkshire Engine Company, has been valued at £23,376 gross.

THE gross value of the estate left by the late Mr. E. Gem, a director of John Bagnall & Sons, Limited, amounts to £21,786.

MR. M. H. HICKS-BEACH has been elected a director of the Gloucester Railway Carriage and Wagon Company, Limited.

THE gross value of the estate of the late Mr. Enoch Baldwin, of Baldwin, Son & Company, Limited, ironfounders, is £39,662.

MR. F. STOBART has been elected a director and Mr. E. J. George secretary and commercial manager of the Consett Iron Company, Limited.

MR. H. SHARP, general manager of Samuel Fox & Company, Limited, Sheffield, has retired, and has been succeeded by Mr. F. Scott Smith.

THE late Mr. P. U. Askham, of Messrs. Askham Brothers & Wilson, Yorkshire Steel and Engineering Works, Sheffield, left estate of the gross value of £1,000.

MR. K. W. LUNDEBERG, the new Prime Minister of Sweden, is one of the leading members of the Swedish steel industry, being the managing director of the Forsbacka Steel Works, near Gefle. He is a member of the Iron and Steel Institute.

THE late Mr. William Stobart left estate of the gross value of £218,422, of which the net personalty has been sworn at £204,658. It will be remembered that the deceased gentleman was chairman of the Wear Steel Works, and director of the Grange Iron Works, the Consett Iron Company, and the North-Eastern Marine Engineering Company.

COMPANY NEWS.

CARGO FLEET IRON COMPANY, LIMITED.—Dividend of 1s. per share.

HENRY BESSEMER & COMPANY, LIMITED.—Interim dividend of 5s. per share.

FRASER & CHALMERS, LIMITED.—Interim dividend of 3 per cent., less income-tax.

JOHN ABBOT & COMPANY, LIMITED.—Dividend passed; loss on the year's operations.

HADFIELD'S STEEL FOUNDRY COMPANY, LIMITED.—Interim dividend of 1s. per share.

FRENCH HARVEY STEEL COMPANY, LIMITED.—Dividend of 50 francs per share.

STEEL COMPANY OF SCOTLAND, LIMITED.—Ordinary dividend, 5 per cent. per annum.

LANG BRIDGE, LIMITED.—Yearly profits, £3,111; final dividend, 4 per cent.; carried forward, £1,600.

JOHN SPENCER & SONS, LIMITED.—Ordinary dividend, 5½ per cent. per annum, free of income-tax.

CARNFORTH HEMATITE IRON COMPANY, LIMITED.—Final dividend of 6 per cent., £3,732 being carried forward.

HORBURY JUNCTION IRON COMPANY, LIMITED.—Ordinary dividend, 5 per cent.; carried forward, £1,040.

PEASE & PARTNERS, LIMITED.—Dividend of 10s. per share on the £10 ordinary shares, carrying forward £4,699.

BURYS & COMPANY, LIMITED.—The directors are unable to recommend any dividend; carried forward, £138.

MARSDEN'S ENGINES, LIMITED.—Dividend of 10 per cent. on the ordinary shares, and £1,226 carried forward.

WIGAN COAL AND IRON COMPANY, LIMITED.—Interim dividend of 3 per cent. per annum for the six months.

WALTER SCOTT & COMPANY, LIMITED.—Half-yearly profits, £38,708; ordinary dividend passed; carry forward, £227.

TINSLEY ROLLING MILLS COMPANY, LIMITED.—Ordinary dividend of 6 per cent., leaving £891 to be carried forward.

NATIONAL GAS ENGINE COMPANY, LIMITED.—Interim dividend of 15 per cent. per annum on the ordinary shares.

RICHARD HILL & COMPANY, LIMITED.—Dividend, 3 per cent.; reserve, £1,500; depreciation, £1,500; carried forward, £3,471.

JOHN BAGNALL & SONS, LIMITED.—Annual profit, £1,925 7s. 5d.; ordinary dividend, 5 per cent.; carried forward, £411 16s. 11d.

MOSS BAY HEMATITE IRON AND STEEL COMPANY, LIMITED. — Annual profit, £21,667; dividend on ordinary shares, 2 per cent.; carried forward, £2,181.

HAWTHORN, LESLIE & COMPANY, LIMITED.—Final dividend of 15s. and a bonus of 5s. per share on the ordinary shares for the twelve months; reserve, £22,000; carry forward, £4,775.

WORKINGTON IRON COMPANY, LIMITED.—Profit for year, £14,817 16s. 4d.; depreciation on works, £5,000; reserve, £750; dividend on ordinary shares, 6¼ per cent.; carry forward, £196 14s. 1d.

GUEST, KEEN & NETTLEFOLDS, LIMITED.—Annual profit, £407,557 4s. 11d.; preference dividend, 5 per cent. per annum; ordinary dividend, 10 per cent. per annum; reserve fund, £150,000; carry forward, £142,808 3s. 10d.

—o—

DURING the month the standard specifications and tables for telegraph material and standards for trolley groove and wire have been issued by the Engineering Standards Committee.

QUERIES.

This department of the JOURNAL *undertakes the answering of queries in foundry practice and pattern-making. We trust our readers will afford us assistance in answering these queries so far as possible.*

MOTOR-CAR CYLINDERS.—The T. P. Company, Limited, write:—We have in mind the making of engine castings for motor-car and bicycle work. The jacket cores of these castings being, in some cases, only $\frac{5}{16}$ in. thick, it is practically impossible to vent them in the usual way, or to use core irons to give the required strength; moreover, it is not possible to use irons, as in most cases they cannot be removed. We have made some experiments with various mixtures to sear a core that will give off a minimum of gas and have a maximum strength, without irons, but with indifferent success. We have made a core that will stand the strain of the metal, but the ingredients are such that cause the mould to blow very badly. To remedy this means making the core so soft that it breaks as soon as the weight of metal comes on it.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

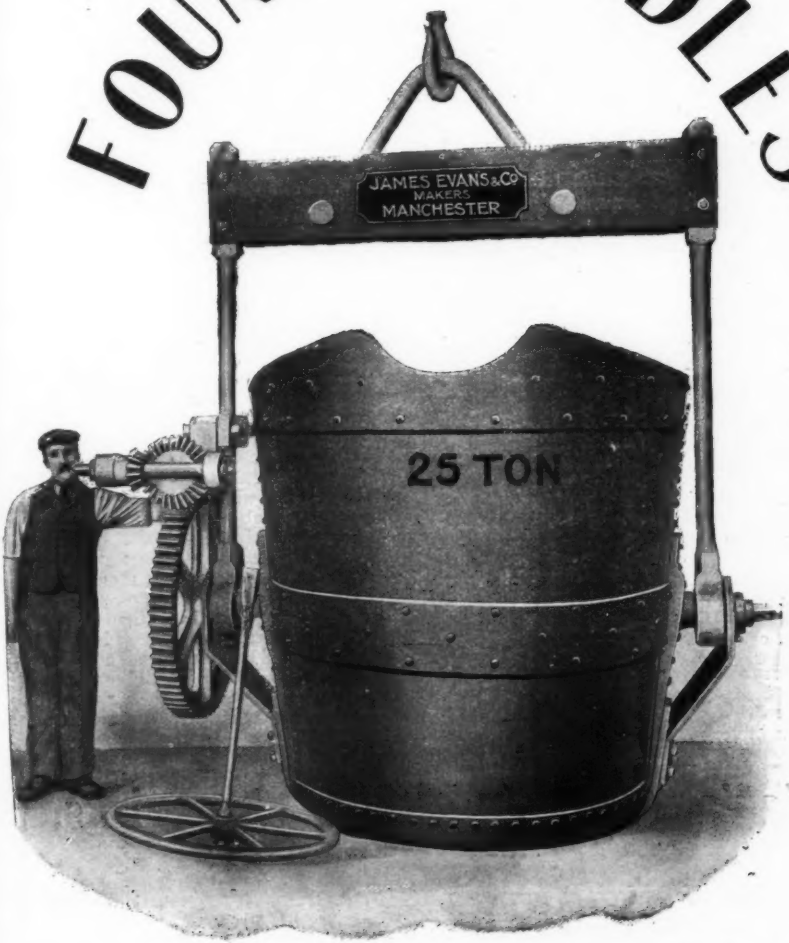
Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

Contractors to H.M. Government.

FOUNDRY LADLES



JAMES EVANS & Co., FOUNDRY ENGINEERS

Telegrams:
"LADLES, MANCHESTER."

BRITANNIA WORKS, MANCHESTER.

Enquiry in the trade shows that at present motor-car engine castings cannot be made perfect with any degree of certainty, because of core troubles. In some cases as high as 75 per cent. of the castings made are wasters, this fact alone being the reason of the high prices for this class of work.

We would like, if at all possible, to make these castings with the same degree of certainty as with ordinary work, and perhaps you can put us in the way of something new in cores that will keep us out of the present difficulty.—T. P. Company, Limited.

Blowholes in Castings.—In our August issue "Troubled" asked for a mixture for stopping-up blowholes in motor-car engine castings. The Plasti-Kion Company, of Albany Buildings, Victoria Street, London, write:—A certain remedy for "Troubled" is Plasti-Kion, which is a metallic cement, admirably suitable for stopping-up blowholes in motor-car cylinder castings, as it contracts and expands with the casting, and when thoroughly set will never work loose. It will withstand a considerable steam pressure, and is invaluable in all sorts of repairs, such as cracks in cylinders, leaky tanks, etc., etc. Easily applied, and always effective.

"Practical" writes:—If it is only one hole, the most successful way would be to fuse it, or, as some call it, "burning." I find it answers the purpose better than stopping. But the better way to remedy the defects would be to stop the blowing, which is, no doubt, caused by wrongly venting.

Enquirer in April issue asked if solid metal floated on molten metal. Mr. C. E. Allen replies:—It is a fact that solid metal will float in molten metal, the cause of which is brought about through the specific density of the molten metal being greater than that of the solid body, *i.e.*, metal.

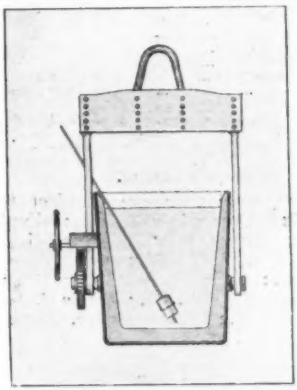
Sigma in our June issue asked:—We are making a number of small brass castings, about ¼ in. thick, and find great trouble in getting them to strip well, and to have a fine skin. Could you suggest any facing to prevent the metal eating into the sand, or any other means of getting out of the difficulty? Mr. C. E. Allen replies:—"Sigma," June issue. If you use fine sand mixed dry with about an eighth of bean flour, pass same through fine sieve, say 25 to 30 mesh, and then reduce to proper working moisture, as a facing you should get smooth castings.

Novice in our July issue asked:—I should like to know what difference of pressure there is on the walls of a mould whose metal is, say, 1 in. thick as against 2 in. Mr. C. E. Allen writes:—"Novice," July issue. The fluid strain or pressure on moulds while being cast is not determined by the thickness of the walls of the mould, but by the surface area and the height of the flow gates. Liquid cast-iron pressed with a force exceeding 1 lb. the square inch, when the column is 4 in. high. Castings are frequently made and cast with a column of liquid iron, 10 ft. high, in which case every inch of the mould exposed to this column has to resist a bursting pressure of more than 30 lbs. Under such circumstances, boxes have to be of great strength, perfectly rigid, and bound together at short intervals with iron bands, in addition to pins and keys. In green sand moulding, the column of metal is usually much less, but the surface extended horizontally, demands nearly the same precautionary measures.

Ganister, Cupola Blocks, Fire Bricks,
Fire Clay.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

PREVENTION OF BLOWHOLES IN CAST IRON.



A tin of our special compound fixed on a rod is held at bottom of ladle as shown; a strong re-action being thereby set up frees the iron from gases and impurities, which rise to the top.

RESULT: A denser casting of finer grain with increased strength.

For Particulars apply to—

THERMIT LIMITED,

27, MARTIN'S LANE, CANNON STREET,

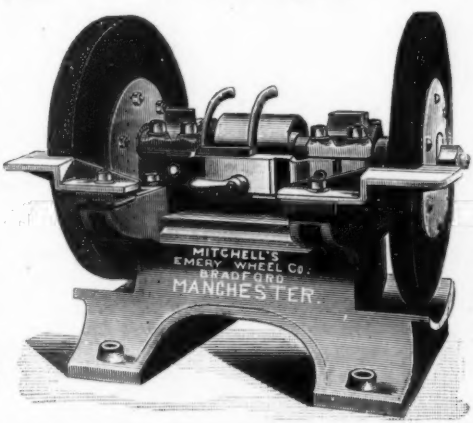
Telephone 3749 Central.
Telegrams—"Fulmen," London.

LONDON, E.C.

MACHINES. For all Purposes. **WHEELS.**

Complete with Emery or Corundum Wheels from £2 upwards.

Special Machines Designed.



Emery or Corundum from 1 in. x $\frac{1}{8}$ in. to 50 in. x 12 in.

Enquiries solicited.

MITCHELL'S EMERY WHEEL Co.,

Mill Street, Bradford, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST. LISTS FREE.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1904-5.	1903-4.
Iron—Scotch pig warrant ... ton	—	—
—Middlesbro' warrants ... ... ton	47/8½	42 10½
—W.C. M/nos Bessemer ... ... ton	57/6	53 6
—Stock, Scotch, Aug. 23 ...tons	17 048	9,560
Copper—Chili bars, GMB ... ... ton	£70 15 0	£57 10 0
—Stock, Europe & afloat... ... tons	18,053	12 867
Tin—English ingots ton	£150 15/0	£124 10/0
—Straits ... ton	£151 17/6	£122 12 6
—Stock, Ldn. Hind and aflt ... tons	13,601	16,237
Lead—English pig ton	£14 6 3	£12
Spelter—Ord. Silesian ... ... ton	£42 17/6	£22 17/6
Quicksilver-(75lb.) bottle	£7 2/6	£7 15 0
Antimony—Regulus ... ... ton	£61 10 0	£26 5 0

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	7 0 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in....	4 7 6	to	4 10 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in....	4 7 6	to	4 10 0
,, 18 to 24 in....	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	2 15 0	to	2 17 6

SCRAP.

The quotation for scrap subject to market fluctuations is as follows: —Engineers' heavy scrap, 50s. to 52s. 6d.; ditto light scrap, 20s. to 22s. 6d.; clean scrap brass, 39s. 6d.; clean scrap copper, 63s.; lead (usual draft), 12s. 3d.; tea lead, 11s. 6d.; zinc, 17s. 6d.; hollow pewter, 100s.; black pewter, 65s. per cwt.

—o—

MESSRS. D. Y. STEWART & COMPANY, of Glasgow, recently obtained a contract, amounting to £3,610, from the Metropolitan Water Board, for the supply of about 525 tons of cast-iron pipes and castings.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

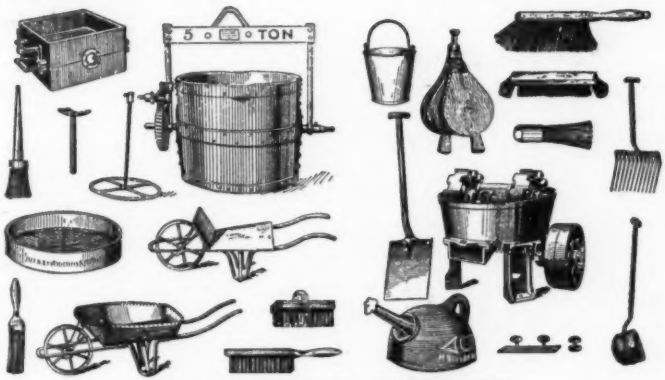
GROUND GANISTER,

Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE,

Nr. Sheffield.

Manufacturers of all

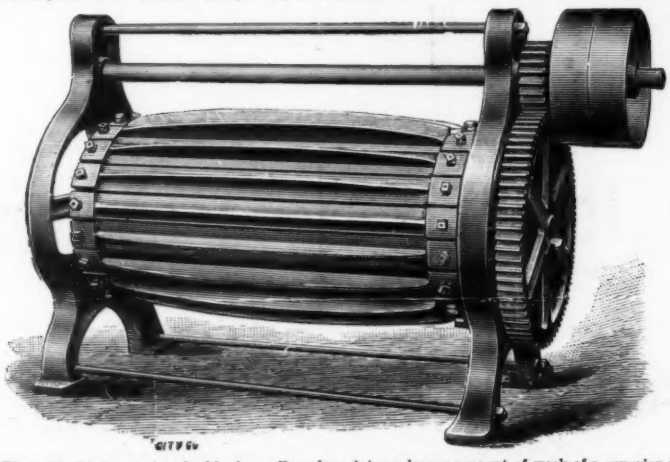
FOUNDRY EQUIPMENTS

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

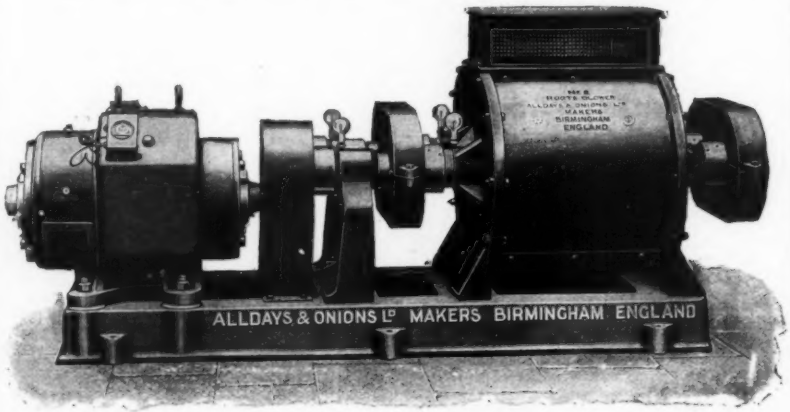
Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

ROOTS BLOWERS.



ALLDAYS & ONIONS PNEUMATIC ENGINEERING CO., LTD., BIRMINGHAM.

AND AT 20 BUCKLERSBURY, LONDON, E.C. Telegrams: "ALLDAYS, BIRMINGHAM."

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McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
36"
32½"

Can also be made in Aluminium.

FOR SALE.

Scott's Wheel Moulding Machine, equal to new.
New 3 ft. 6 in. Loam and Sand Mill.
New Moulding Sand Mixer. Capacity, 5 to 10 tons per hour.
Thwaite's Root's Blower, 11½ in. discharge.
Thwaite's Root's Blower, combined with Vertical engine. Melting capacity, 3 tons per hour.
No. 4 Root's Blower, by Alldays, to blow 50 fires.
30 in. Revolving Blast Fan.
No. 3 Sturtevant High-pressure Fan, 24 in. diameter.
No. 1 Silent Blowing Fan, suitable for 7 fires, 11 in. diameter.
Blowing Fan by Lloyd, 36 in. diameter.
New Lloyd's Patent Noiseless Fan, for 9 fires.
Do. Do. for 2 fires.
Do. Do. for 6 fires.
Do. Do. for 4 fires.

Send for Illustrated List of Phillip's New Improved Foundry CORE OVENS.

IRON AND BRASS CASTINGS.

CHARLES D. PHILLIPS,

Emlyn Engineering Works and Foundry,
NEWPORT, MON., AND GLOUCESTER.

HUB IS NOT THROWN AWAY

when our

ECONOMY BRUSH

is worn out, because you can place fresh layers of Steel Wire on it yourself.

Used on Emery Grinders, they are found invaluable for

CLEANING CASTINGS.

Many other uses are always being found for them.

THE SPECIAL WIRE DOES NOT LAY DOWN OR BREAK OFF.

SIZES, 15 INCHES DIAMETER DOWN TO 8 INCHES.

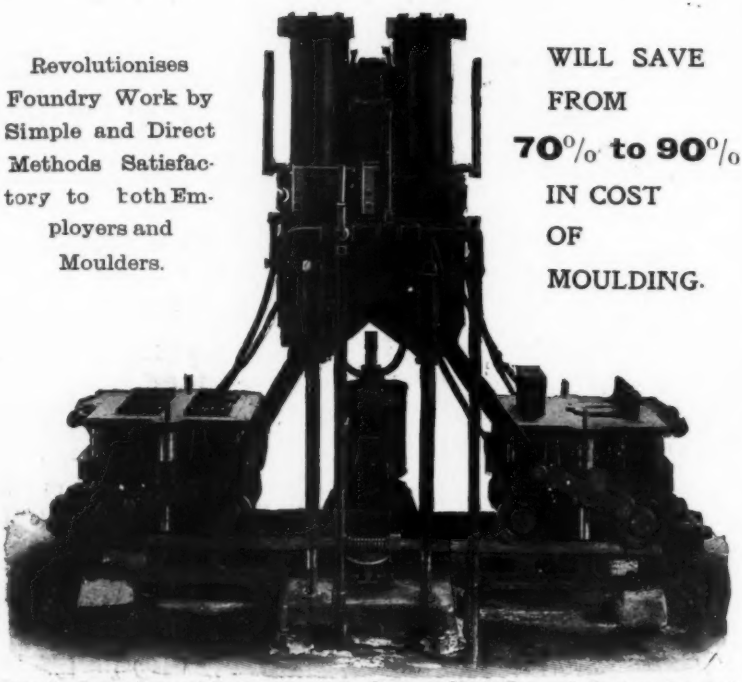
J.W.&C.J.PHILLIPS,

College Hill, London, Eng.

The McClelland Patent

SAND MOULDING MACHINE

Revolutionises Foundry Work by Simple and Direct Methods Satisfactory to both Employers and Moulders.



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Type A.—Power Operated Carriage run under Rammer, Mould Rammed, Carriage Returned and Box Lifted, all Automatically. Arranged or one or two men to work continuously.

NO OTHER SAND MOULDING MACHINE HAS THE SPEED, SIMPLICITY AND STRENGTH OF THIS.

TURNS OUT BETTER MOULDS AND CASTINGS THAN BY HAND.

THE SAFETY TREAD SYNDICATE,

15, BARBICAN, LONDON, E.C.

Telephone, 5646 Bank. Telegraph, "Unslipping," London.

SITUATIONS VACANT AND WANTED.

BRASS-MOULDER FOREMAN wants situation; any class of work; age 35; last place 7 years; good references.—Address, Box 196, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

ENGINEER, about 30 years of age, Wanted for Rangoon; a qualified man accustomed to take charge of engines and machinery; good Draughtsman and Pattern Maker essential; knowledge of Hindustani an advantage; good salary to a suitable man.—Apply, Box 198, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

FOR SALE AND WANTED.

FOR SALE, "Root's" Patent and other Foundry Blowers.
No. 2A size by "Daglish," Glasgow, 4½ in. outlet
No. 1A " " "Allday," Birmingham, 6 in. "
No. 3 " " "Wilkinson's" Patent, 6 in. "
No. 5 " " "Thwaites" " 14¾ in. "
"Lloyd's" Patent Fan as new, 8 in. "
—For full details address J. LIGHT, Wolverhampton.

CASTINGS.—For Good, Sound Machinery Castings, in Green or Dry Sand or Loam, up to 15 tons in weight, and Machined if required, apply to ROSE, DOWNS, AND THOMPSON, LTD., Old Foundry, Hull. Special Quotations for Quantities.

THE well-known FINE RED MOULDING SAND, for Iron, Brass, Aluminium, &c.—Apply MANSFIELD SAND CO., LTD, Mansfield, Notts.

FOR SALE AND WANTED.—

continued.

CRUCIBLE STEEL CASTINGS for Collieries, Works, and Engineers, from customers' patterns; machined if desired.—P. T. WOODRUFF AND CO., Machen, Newport, Mon.

FIVE LATHES, length of beds 6 ft. to 27 ft.; Two Drilling Machines, One Planing Machine, One Shaping Machine, One Screwing Machine; Low Prices.—ATLANTIC WORKS COMPANY, Newport.

MISCELLANEOUS.

FIRMS interested in the trade of Sweden and Norway (both import and export) should write "SWEDISH," BOX 195, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, W.C.

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Are Makers of
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WRITE FOR QUOTATIONS.

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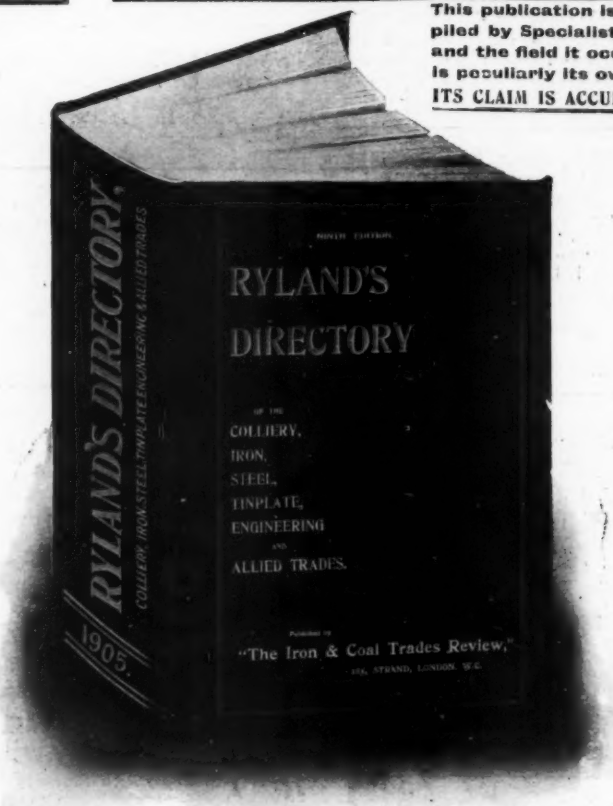

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